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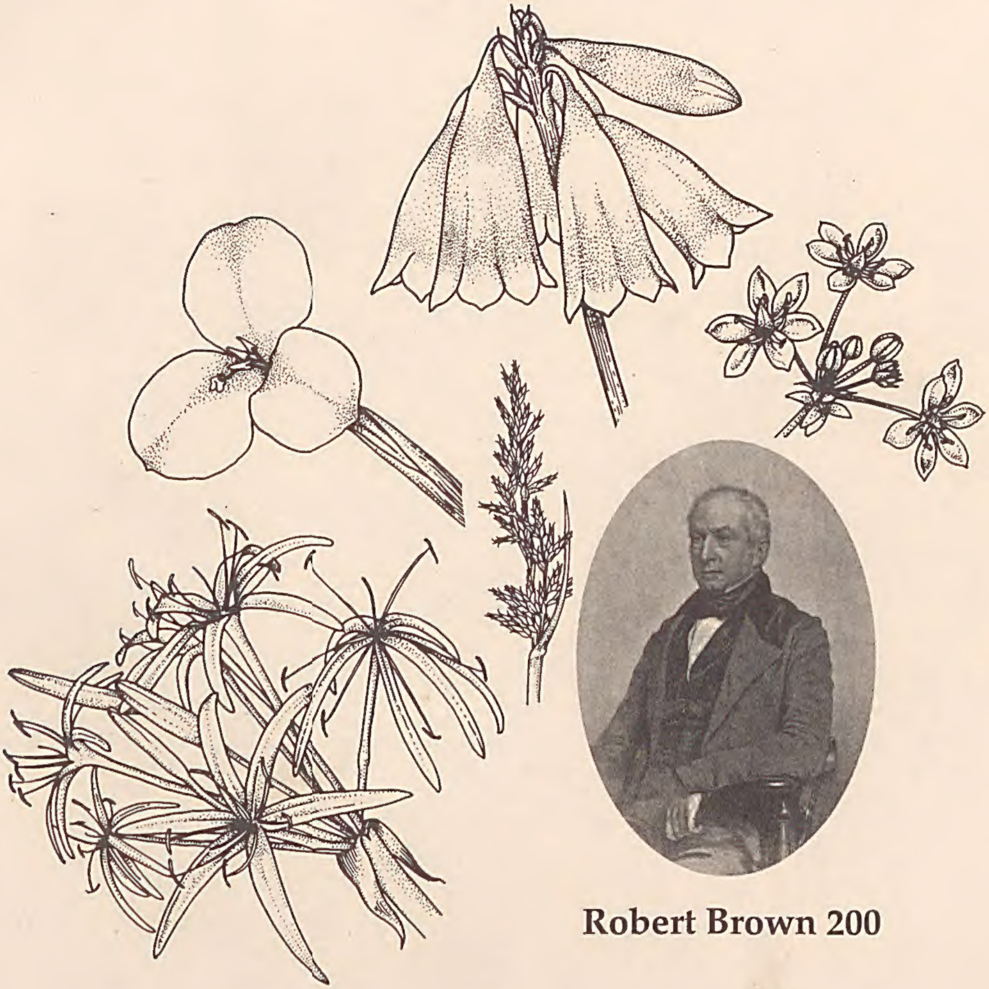
## A journal of plant ecology for eastern Australia



**Robert Brown 200**

ROYAL BOTANIC GARDENS SYDNEY
National Herbarium of New South Wales

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COVER

Plant species clockwise from bottom left: *Crinum pedunculatum, Lepidosperma concavum, Patersonia glabrata, Blandfordia grandiflora, Burchardia umbellata.*

Illustrations from Harden, G.J. (ed.) Flora of New South Wales Vol. 4 (NSW University Press: Kensington).

Photo of Robert Brown from Maiden, J.H. (1909) Sir Joseph Banks: the 'Father of Australia' (William Applegate Gullick, Government Printer: Sydney).

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**Volume 7(4) • 2002**

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Allan Cunningham

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# Robert Brown 200: Introduction

## David Mabberley

*Mabberley, D. (Nationaal Herbarium Nederland, University of Leiden, The Netherlands, and Royal Botanic Gardens and Domain Trust, Sydney, NSW Australia 2000) 2002. Robert Brown 200: Introduction.* Cunninghamia *7(4): 613–615.*

This issue of *Cunninghamia* includes a number of papers presented at **Robert Brown 200**, an international conference celebrating Robert Brown's time in New South Wales and his contribution to science. This conference, held at the Royal Botanic Gardens Sydney on 8–10th May 2002, was one of a series around Australia, to celebrate the successes of Matthew Flinders' voyage, two hundred years after the *Investigator* touched various points in its circumnavigation of the Australian coast. Robert Brown (1773–1858) was selected by Joseph Banks as naturalist for the voyage and in May 1802, arrived in Sydney Cove: he was to spend much of the next three years based in New South Wales (for biographical details of Brown see Mabberley 1985).

Brown's lasting contribution to the study of the Australian flora was considered on Day 1 of the Conference and relevant papers will be published in the Royal Botanic Gardens journal of plant systematics *Telopea,* volume 10(2) in 2003. For ecologists his work is perhaps most familiar in being reflected in the species authority 'R. Br.', the standard abbreviation for his name. Indeed, here in Australia we tend to grasp to us Brown, like George Bentham later, for his work on our flora, but they both worked on the plants of other parts of the world. Brown's next greatest contributions were probably on the flora of Africa — notably the Congo basin, but also west Africa and Ethiopia, besides Madeira and the Arctic. This work had a major influence on von Humboldt, but also Lyell and through him Darwin.

On Day 2 some of the places Brown visited on his fieldwork around Sydney were visited and Day 3 looked at what has happened to Australian vegetation, particularly that of the Sydney Basin, and what we are doing about it. The importance of New South Wales in his subsequent work can be gauged from an examination of the relative numbers of gatherings Brown made in the state compared with the rest of the country (Figure 1).

Brown was interested in documenting the diversity of the Australian flora and fauna but did not gather 'ecological vouchers' in that if he had a good collection of a particular species he was not going to spend a lot of time collecting it over and over again from different localities. However, he did make important *florulae* or 'mini-floras' of places where he spent a good deal of time and these are benchmarks for our ecological knowledge of vegetation at the beginning of the nineteenth century. These are now printed with his diary, recently transcribed (Vallance et al. 2001), but it must be admitted that he has tantalisingly little to say on the clearing of the vegetation by Europeans, though he does remark on it in the Hunter Valley, where cedar-getting was well-advanced. The two artists on the voyage, William Westall and Ferdinand Bauer, perhaps recorded more in this respect; the drawings of the landscape artist, Westall, notably those of the Hawkesbury area, are very important documentary records. Brown's botanico-horticultural assistant Peter Good made some useful observations and these, too, have been published (Edwards 1981).

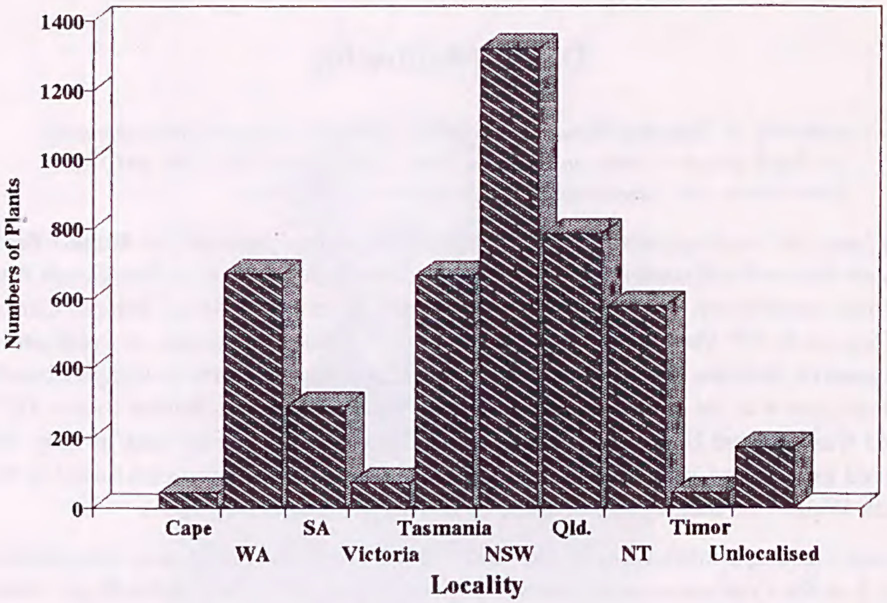

**Fig. 1.** Brown's plant collecting, 1801–1805, on the *Investigator* voyage (from Moore & Groves 1997, reproduced with permission from *Archives of Natural History*).

In 1802 Brown spent ten weeks in New South Wales before setting off northwards in the *Investigator* for Flinders's circumnavigation of the continent: during this time he visited Parramatta and the Windsor area, meeting Banks's resident collector, George Caley. He also collected at Botany Bay and the original mouth of Cooks River.

On the return of the *Investigator* in June 1803 he was here for some six months. Besides working in the Hawkesbury area, he also did fieldwork along the Georges River and near Camden, *the Cowpastures* as it was then called, and collected on the Sydney's North Shore as well as at South Head.

During his third stay in NSW from August 1804 until the patched-up *Investigator* left for England in 1805 to take him and his materials back to Europe, he sailed for *King's town*, present-day Newcastle; there in the coal, he probably collected the fossil *Glossopteris*, now bearing his name, *Glossopteris browniana*. He surveyed up the Hunter to the Morpeth–Maitland area and ascended Mt Hudson. He also worked the courses of the Williams and Paterson rivers ascending Mt Johnstone. He completed a *Florula* of the Lower Hunter area as he knew it, and, after more fieldwork near Windsor, he also produced a *Florula* of the Grose River area.

The Robert Brown 200 conference was not about looking back for its own sake: it saw Brown's time here as a benchmark and the papers presented here deal with issues from that perspective: the spread of exotic species into a new continent (Groves page 623), the changes that have taken place in the Cumberland Plain in western Sydney (Benson & Howell page 631) and the concept of rarity and the conservation of rare species (Adam page 651).

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# George Caley –
# Robert Brown's collecting partner

Joan B. Webb

*Webb, Joan B. (10/48 Khartoum Rd North Ryde NSW 2113) 2002. George Caley – Robert Brown's collecting partner.* Cunninghamia *7(4): 617–621. (Poster presented at Robert Brown 200 conference.)*

George Caley (1770–1829) collected plant specimens for Joseph Banks in the colony of New South Wales from 1800 to 1810. This paper outlines Caley's contacts with Robert Brown in New South Wales in 1802 and subsequent years; his contacts with Brown back in England; their collecting forays in the colony, and Brown's respect for Caley's ability and botanical knowledge.

George Caley (1770–1829) collected plant specimens for Joseph Banks in the colony of New South Wales from 1800 to 1810. His altercations with Governor King and the Rev. Samuel Marsden, and his reputation as an irascible character have coloured the historical record so that his botanical contribution has often been minimised (Webb 1995). But Robert Brown saw evidence of Caley's ability during their contacts in the colony, and their friendship continued when Caley returned to England in October 1810. This paper is based on a poster displayed at the Robert Brown Conference in Sydney, in May 2002, and outlines George Caley's contacts with Robert Brown in New South Wales and subsequently in England.

## George Caley and Robert Brown

The *Investigator* arrived in Sydney on 9 May 1802 (Vallance et al. 2001). As early as 18 June 1802, Robert Brown and the gardener Peter Good, and perhaps Ferdinand Bauer too, walked with Caley from Parramatta (Caley's base) to North Rocks, a distance of six or seven miles (10–11 km). Brown recorded in his diary, 'A few plants found … Caley accompanied us … his loquacity, his names of plants generic. Mostly bad Greek. However he is an observer and should be encouraged … his collection not numerous but well preserved … '.

The next day the party, including Caley, walked to Castle Hill and returned to dinner at Parramatta. They then went on to Windsor and across the Nepean into the mountains near the Grose River, 'its banks steep and rocky, but not perpendicular.' There is no record in Brown's diary of Caley being present on this later excursion.

The *Investigator* was in Sydney for twelve weeks, and left on 21 July to complete Matthew Flinders' survey of the coastline. The ship returned to Sydney in June 1803, the ship's hull so rotten that she could have foundered at any time. Flinders decided to return to England with his charts in the *Porpoise,* the only ship available. Brown selected the best of his specimens to return also, while he and Bauer elected to stay until the *Investigator* could be repaired.

Governor King was anxious to help, and wrote to Banks in September 1803, 'I have supplied Mr Brown with a very good apartment of boxes for the *Porpoise's* plant cabin ... Caley is very angry because he cannot get the same boxes ... I have given directions that some should be made for him. I believe he is very angry at having Mr Brown here, who he cannot help considering as a laborer in the field that ought to be wrought by himself. He has all he wants but is by no means satisfied.'

This animosity towards Caley may or may not have been justified, but King's comments are not supported by Caley's own words to Banks in a letter of 7 August 1803, 'I am glad that Mr Brown will remain some length of time here ... in some respects I flatter myself I may benefit him in showing him the most likely places to meet with new plants ... on the other hand, I know I shall be much benefitted by Mr Brown for in general, until the present, I have nobody to discourse upon the same pursuit, for want of which, the pleasures of the study were abstracted.'

On 19 October 1803, Caley took Brown to the Cow Pastures, an area to the south of Sydney near Camden that Caley had already explored; Brown collected a number of new specimens on their four-day excursion. At the end of November Brown left in the *Lady Nelson* to go to Tasmania for what was to become a protracted stay, longer than he had anticipated. He was not to return until August 1804.

On 14 September 1804, Brown walked to Parramatta; the many references to Caley's work for this day in Brown's diary indicate that the two men spent some time comparing specimens. Caley's animal collection was also examined. The next day was also spent with Caley, who showed Brown his orchid collection. Four days later they were both in Sydney to meet Colonel William Paterson who examined with interest Brown's collection from Port Dalrymple (George Town) and the River Derwent in Tasmania.

Caley gave a number of his choice specimens to Brown, always with a generic and specific name attached, but in his later publications, and in his processing of specimens for the herbarium, Brown did not always acknowledge Caley's contribution. Groves and Moore (1989) in their paper on Brown's collection in Australia refer to an herbarium sheet of the fern *Adiantum hispidulum,* supposedly gathered by Brown. Three old labels accompany the sheet, one indicating 'Port Jackson' with no date, the second 'North Rocks August 1802' and the third 'Dove Dale Feb. 1804.' Vallance (1990) points out that the first, of course, might be due to Brown, but the lack of date is no help. As to the other two, Brown was away with Flinders in August 1802, and in Tasmania in February 1804. Vallance concludes that the North Rocks and Dove Dale records are annexed from Caley. Another specimen, an orchid *Pterostylis nutans* (Caley's Druid's Cap Dicksoni) is attributed to Brown (Clements 1989), 'Port Jackson, North Rocks, Jul. 1804. R.Brown.' This is not possible, as Brown was in Tasmania at this time. These errors may not necessarily be a deliberate evasion by Brown, but the evidence seems conclusive that Brown published a number of Caley manuscript names without acknowledgement. Brown and Bauer, with their massive collection, left Sydney on 23 May 1805.

Brown developed a high regard for Caley's work and was the first botanist, after Banks and Dryander, to have the opportunity to examine Caley's plant specimens and use them for his publications. On 17 January 1809, Brown read a paper to the Linnean Society. In his closing remarks he said, 'Besides the Proteaceae described or noticed in this paper, I am acquainted with several very beautiful species, chiefly of *Grevillea* and *Persoonia,* discovered in New Holland by Mr George Caley, a most assiduous and accurate botanist, who, under the patronage of Sir Joseph Banks, has for upwards of eight years being engaged in examining the plants of New South Wales, and whose numerous discoveries will, it is hoped, be soon given to the public, either by himself, or in such manner as to obtain for him that reputation among botanists to which he is well entitled.'

In Brown's *Prodromus* of 1810, p. 329, he wrote in his dedication of the orchid genus *Caleana,* in Latin, '*Genus pulchrum et valde distinctum dixi in honorem Georgii Caley, botanici periti et accurati …* ' in honour of George Caley, a skilful and accurate botanist.

Caley was well received by the botanical fraternity when he returned to England late in 1810, 'Mr Dickson called on me and I went with him to town — then to Sir Joseph's and afterwards to Mr Brown's.' (Caley's Diary, 1811). James Dickson was a leading cryptogamic (non-flowering plants) botanist with a successful herb and seed shop in Covent Garden. He was one of the founders of the Horticultural Society of London and the Linnean Society, and it is significant that he befriended Caley and continued to give him support during the years Caley remained in England.

In August 1811 Caley settled down in a rural area about 10 km north-east of Manchester, occupied with cleaning, sorting and naming his specimens. He continued to correspond with Brown and Banks. Brown visited Caley in Manchester in October 1815, Caley having written to Brown in July, 'If you can in any shape put up with a Botany Bay reception, I will endeavour to make you as comfortable as I can, and shall be glad of your company … '.

After Caley's death in 1829, Brown (1830) published a paper on the Proteaceae, naming *Grevillea caleyi* R. Br., a plant, now rare, first found by Caley in 1805 near Belrose (a Sydney suburb not far from Narrabeen Lagoon). Caley wrote an account of this four-day journey, 'A Journey to the Sea', which took him from Captain Macarthur's farm at Pennant Hills (west of Sydney), through present day St Ives to Narrabeen Lagoon and the sea. He returned by the upper reaches of Middle Harbour (Caley 1805).

## Caley and the eucalypts

It is fitting that the last word on Caley and Brown concerning the eucalypts, a major component of Sydney vegetation, should come from Dr L.A.S. Johnson, late Director of the Royal Botanic Gardens, Sydney. In 1988 Dr Johnson stated that he had gained an impression from examination of Caley's specimens and notes that he (Caley) knew much more about the Port Jackson eucalypts than anyone else for the next half century or more. Robert Brown did not study the eucalypts in depth; George Bentham struggled with them but was unable to do a really good job as he was not on the spot, as Caley had been. Perhaps Caley's greatest contribution to Australian botany is that he was the first to recognise hybridization in the genus *Eucalyptus,* which he did as early as 1810; later more eminent workers, such as the Rev. Dr William Woolls and the great Ferdinand von Mueller believed such did not, and could not, happen. Today it is well accepted that hybrids do commonly occur (L.A.S. Johnson pers. comm. 1988).

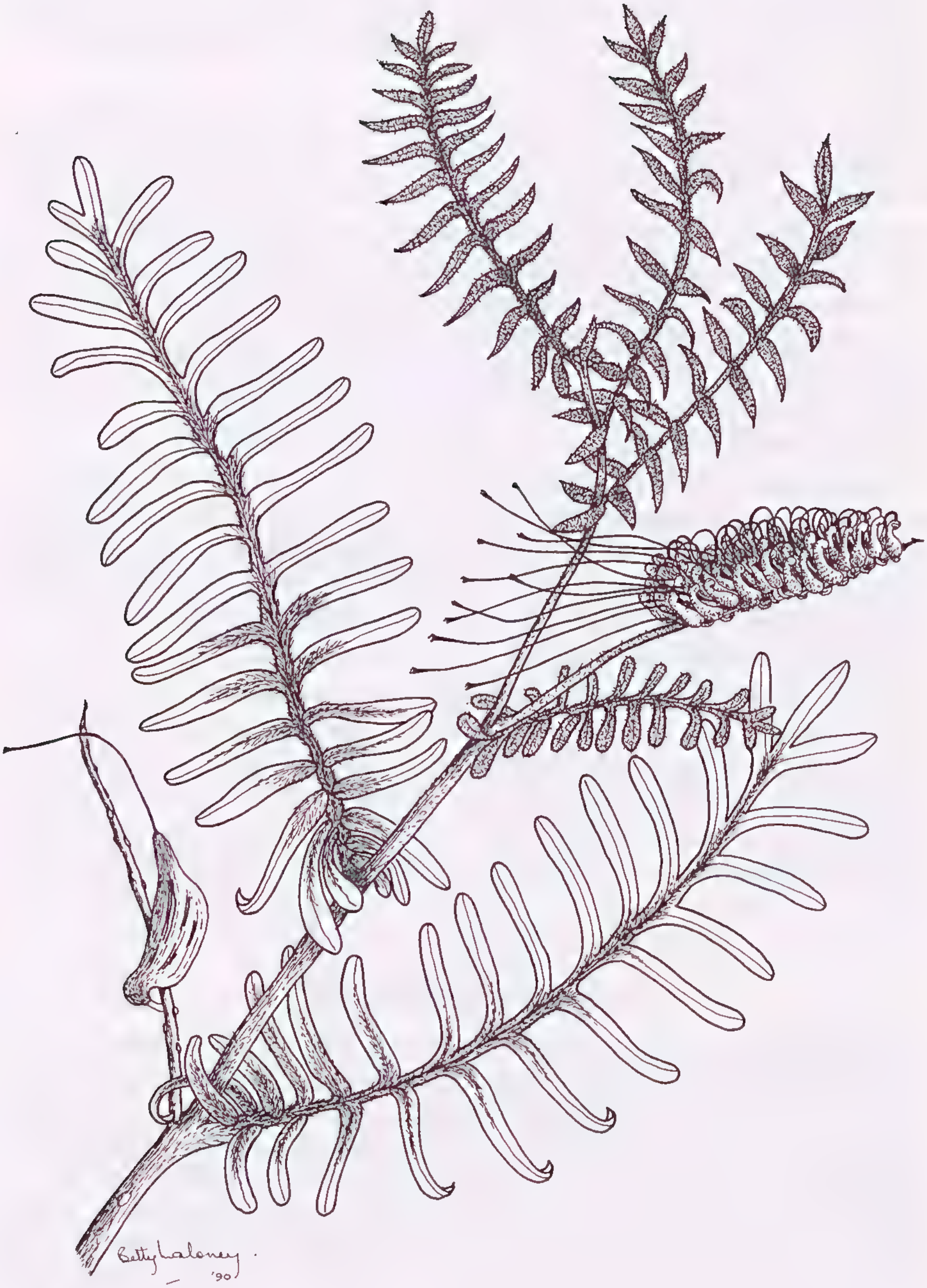

Fig. 1. *Grevillea caleyi* R.Br., collected by Caley near Belrose in 1805, and now listed as Endangered because of its very restricted geographic distribution.

Joseph H. Maiden, another Director of Sydney's Botanic Gardens said, in dedicating a New England Ironbark, *Eucalyptus caleyi,* to Caley's memory, 'The vernacular name, "Caley's Ironbark", is short; it commemorates a worthy pioneer botanist whose work requires much more emphasis than it has hitherto received.' (Maiden 1904–1924).

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Manuscript accepted 21 January 2003

# Robert Brown and the naturalised flora of Australia

## R.H. Groves

*Groves, R.H. (CSIRO Plant Industry & CRC Australian Weed Management, GPO Box 1600, Canberra, ACT Australia, 2601) 2002. Robert Brown and the naturalised flora of Australia.* Cunninghamia *7(4): 623–629. (Paper presented at Robert Brown 200 conference.)*

Robert Brown noted 29 introduced plant species around Sydney and Parramatta between 1802 and 1804. The list, contained in Brown's miscellaneous papers, was not published by Brown at the time of writing but had to wait for James Britten to publish it in 1906, along with Brown's accompanying notes in Latin. In 1909 Maiden re-published the list for an Australian audience and in 1916 he translated the notes into English and updated the nomenclature of some species.

Brown's list represents the first documentation of Australia's naturalised flora following European settlement of Australia's east coast. Although several of the 29 introduced plant species listed were not considered 'weeds' at the time, most of the 29 have spread subsequently to become common components of the naturalised flora throughout Australia. Nomenclature and current distribution of these 29 species are presented in the context of the approximately 2800 taxa now comprising the *naturalised flora of Australia.*

### Introduction

In the course of his travels in and around Australia between 1801 and 1805, Robert Brown collected many plant species not previously known. The extent of those collections and their subsequent determination and naming were central to establishing the systematic study of the Australian flora as a distinct and fascinating field of scientific endeavour. Two hundred years after his arrival with Flinders, Good and Bauer, the results of Robert Brown's time in Australia are indeed worthwhile celebrating. Whilst Brown's collection of indigenous plants is what is rightly noted, it is little known and even less appreciated that he also observed some European plants while he resided in the Sydney region for several periods between 1802 and 1804. These European species presumably had been introduced to Sydney in the 14 years since 1788 as seed contaminants in soil, stock feed and crop seed supplies from England or, in the case of four crop species, deliberately (Frost 1993). Already by 1804, some of these species had begun to interfere with cropping and gardening in the embryonic settlements of Parramatta and Sydney and many may be considered as Australia's first weeds.

This contribution draws attention to the 29 introduced plant species recorded by Robert Brown and updates their nomenclature and current distributions. Two hundred years later, Brown's group of species comprises some major weeds of agricultural and natural ecosystems, even though it represents only about one hundredth of the total known number of naturalised plant species now present in Australia.

## Robert Brown's list of introduced plants of the Sydney region, 1802–4

During his collecting trips around Sydney, Brown noted some plants familiar to him from his British background. The names of the plants so noted were not published but remained among the '74 folios of Brown's notes (B8.2) at the Natural History Museum … ' in London (Moore et al. 2001). The list in Latin was published by James Britten about 100 years later (Britten 1906). In this list (Table 1), the identity of two species was queried. There were no specimens from Brown of *Lepidium didymum (Senebiera didyma)* in the Herbarium. Britten could find no mention of *Malva capensis (Malvastrum capense)* elsewhere as an introduced plant; in addition, there were no specimens from Brown, nor any reference to it in his manuscripts. This particular plant was collected in 'the town of Sydney near D. Chapman's house' (Maiden 1916). The taxonomic identity of these two taxa remains questionable and they are indicated by question marks in the original list (Britten 1906), as well as in Table 1.

**Table 1.** *Plantae introductae vicinitatis Portus Jackson.* Robert Brown's list of introduced plants at Sydney 1802–4 as published by Britten (1906).

*Plantago major.* Ubique ad margines viarum.
*Nicotiana Tabacum.* In ruderatis et ad vias prope Sydney.
*Datura.* In ruderatis ad Sydney et Parramatta.
*Solanum sodomeum*
*Physalis pubescens*
*Asclepias fruticosa*
*Daucus Carota*
*Apium graveolens*
*Silene anglica.* Prope Sydney.
*Lythrum hyssopifolium.* Ad vias prope Sydney.
*Euphorbia Peplus.* In hortis ubique.
*Fragaria vesca*
*Stachys arvensis.* Prope Sydney.
*Erodium moschatum.* Ad Parramatta.
? *Lepidium didymum.* Ubique ad vias.
*Vicia sativa*
? *Cotula coronopifolia*
*Malva capensis.* Ad oppidium Sydney prope domum D. Chapman.
*Poa annua*
*Panicum Dactylon*
*Phalaris canariensis*
*Lolium temulentum.* In agris frequens vitium.
*Lolium perenne.* Rarius ad vias.
*Briza virens* [*minor*]. Prope domum Gubernatoris ad Sydney.
*Anagallis caerulea.* Prope domum D. Caley ad Parramatta.
*Scleranthus annuus.* In hortu D. Caley.
*Cerastium vulgatum.* In hortu D. Caley.
*Anagallis arvensis.* In vicinitate Sydney.
*Urtica urens.* In ruderatis, &c., prope Sydney.

Maiden subsequently re-published the list, first in Latin (Maiden 1909) and subsequently in English (Maiden 1916), for a local audience and noted that, 'It is a fragment, with no pretence at completeness, but is a valuable record of weed introduction' (Table 2 from Maiden 1916). Maiden added some extra notes in brackets and suggested (correctly?) that the listing of *Scleranthus annuus* as occurring in Mr Caley's garden at Parramatta was, 'perhaps a mistake, as this species has not been recorded lower down than the Blue Mountains' (Maiden 1916). The present known distribution of *Scleranthus annuus* is confined, however, to the Northern Tablelands and the Northern and Southern Far Western Plains (Harden 1990), so that the real identity of Brown's taxon is now even less clear.

**Table 2.** Introduced plants at Sydney 1802–4. Robert Brown's list as published by Maiden (1916), with Maiden's notes in brackets.

*Plantago major,* everywhere by roadsides (Large-leaved Plantain).
*Nicotiana Tabacum,* on rubbish-heaps and by roadsides near Sydney (Tobacco).
*Datura,* on rubbish-heaps between Sydney and Parramatta (*Stramomium,* J.H.M., The Thorn Apple).
*Solanum sodomeum* (The common prickly Apple of Sodom).
*Physalis pubescens* (*P. peruviana,* the Cape Gooseberry).
*Asclepias fruticosa* (*Gomphocarpus fruticosus,* the Silk-cotton bush).
*Daucus Carota* (Wild Carrot)
*Apium graveolens*
*Silene anglica,* around Sydney (*S. gallica,* the Catchfly).
*Lythrum hyssopifolium,* along roads around Sydney.
*Euphorbia Peplus,* everywhere in gardens.
*Fragaria vesca* (Wild Strawberry).
*Stachys arvensis,* near Sydney (Stagger Weed).
*Erodium moschatum,* at Parramatta (Musky Crowfoot or Cranesbill).
?*Lepidium didymum,* everywhere by roadsides (Pepper Weed).
*Vicia sativa* (Vetch).
?*Cotula coronopifolia.*
*Malva capensis,* in the town of Sydney near D. Chapman's house (*Malvastrum capense.* Evidently a mistake).
*Poa annua.*
*Panicum Dactylon* (*Cynodon dactylon,* the Couch Grass).
*Phalaris canariensis* (Canary Grass).
*Lolium temulentum,* a frequent pest in fields (Darnel).
*Lolium perenne,* somewhat rare on roads (Rye Grass).
*Briza virens (minor),* near Government House, Sydney (Nodding Grass).
*Anagallis coerulea,* near Mr. Caley's house at Parramatta. (He was Sir Joseph Banks' collector in New South Wales, 1800–10. See the *Gazette* for 1903, p. 988. Blue Pimpernel.)
*Scleranthus annuus,* in Mr. Caley's garden. (Perhaps a mistake, as this species has not been recorded lower down than the Blue Mountains.)
*Cerastium vulgatum,* in Mr. Caley's garden (Mouse-ear Chickweed).
*Anagallis arvensis,* round about Sydney (Scarlet Pimpernel).
*Urtica urens,* on rubbish heaps, &c., around Sydney (the Small Nettle).

The nomenclature of the species on both Brown's and Maiden's lists has been updated in Table 3, based largely on Harden (1990–1993), although a few queries remain as to the true identity of several taxa. Whatever Brown listed as *Lythrum hyssopifolia* and *Cotula coronopifolia,* each is now considered to be native (Harden 1991), as is some material of *Cynodon dactylon* by certain herbaria (B. Lepschi pers. comm.). The identity of Brown's *Fragaria vesca* as Wild Strawberry remains somewhat uncertain, and Maiden's query regarding *Scleranthus annuus* in Caley's garden at Parramatta persists. The taxa *Anagallis coerulea* and *Anagallis arvensis* (Blue and Scarlet Pimpernel respectively) are listed separately by Brown but are probably now best considered as infraspecific variants of *Anagallis arvensis* (see note in Harden 1990).

**Table 3.** The list of introduced plants collected by Robert Brown in the Sydney region between 1802 and 1804, with their taxonomy up-dated by Maiden (1916) and as in Harden (1990–1993), together with their present known Australian distributions.

| **R. Brown (1804)** | **J. Maiden (1916)** | **G. Harden (1990–1993)** | **Present Australian Distribution** |
|---|---|---|---|
| *Plantago major* | *P. major* | *P. major* | Qld, NSW, Vic., Tas., S.A., W.A. |
| *Nicotiana Tabacum* | *N. tabacum* | *N. tabacum* | Qld, NSW, Vic. |
| *Datura* | *D. stramonium* | *D. stramonium* | all States |
| *Solanum sodomeum* | *S. sodoneum* | *S. linnaeanum* | Qld, NSW, Vic., S.A., W.A. |
| *Physalis pubescens* | *P. peruviana* | *P. peruviana* | all States except N.T. |
| *Asclepias fruticosa* | *Gomphocarpus fruticosus* | *G. fruticosus* | Qld, NSW, Vic., S.A., W.A. |
| *Daucus Carota* | *D. carota* | *D. carota* | NSW, Vic., Tas., S.A., (W.A.)* |
| *Apium graveolens* | *A. graveolens* | *A. graveolens* | all States except Qld |
| *Silene anglica* | *S. gallica* | *S. gallica* | all States except N.T. |
| *Lythrum hyssopifolium* | *L. hyssopifolium* | *L. hyssopifolia* | all States except N.T. |
| *Euphorbia Peplus* | *E. peplus* | *E. peplus* | all States except Qld |
| *Fragaria vesca* | *F. vesca* | *F. vesca* | Qld |
| *Stachys arvensis* | *S. arvensis* | *S. arvensis* | all States except N.T. |
| *Erodium moschatum* | *E. moschatum* | *E. moschatum* | NSW, Vic., S.A., (W.A.)* |
| *?Lepidium didymum* | *L. didymum* | *Coronopus didymus* | all States except N.T. |
| *Vicia sativa* | *V. sativa* | *V. sativa* | NSW, Vic., Tas., S.A., W.A. |
| *?Cotula coronopifolia* | *C. coronopifolia* | *C. coronopifolia* | all States except N.T. |
| *Malva capensis* | *Malvastrum capense* | *M. americanum* | all mainland States |
| *Poa annua* | *P. annua* | *P. annua* | all States except N.T. |
| *Panicum Dactylon* | *Cynodon dactylon* | *C. dactylon* | all States |
| *Phalaris canariensis* | *P. canariensis* | *P. canariensis* | all States except N.T. |
| *Lolium temulentum* | *L. temulentum* | *L. temulentum* | NSW, Qld, S.A., W.A. |
| *Lolium perenne* | *L. perenne* | *L. perenne* | all States |
| *Briza virens* | *B. minor* | *B. minor* | all States except N.T. |
| *Anagallis coerulea* | *A. coerulea* | *A. arvensis* | all States except N.T. |
| *Scleranthus annuus* | *?S. annuus* | *?S. annuus* | ?NSW, Vic., Tas. |
| *Cerastium vulgatum* | *C. vulgatum* | *C. fontanum* subsp.*vulgare* | NSW, Vic., Tas. |
| *Anagallis arvensis* | *A. arvensis* | *A. arvensis* | all States except N.T. |
| *Urtica urens* | *U. urens* | *U. urens* | all States |

*see Hussey et al. (1997)

From the present distributions of the 29 weeds that Brown listed, as given in Harden (1990–1993), it is clear that most of them have spread extensively since Brown noted them on his collecting trips around Sydney (Table 3). All taxa still occur in New South Wales and most have spread widely to other Australian states and territories. With the possible exception of what Brown called *Fragaria vesca,* all the other species now occur widely throughout the continent, with only two (the uncertain record of *Scleranthus annuus* and of *Nicotiana tabacum*) being confined to two states other than New South Wales (Table 3). Within New South Wales, most species occupy the coastal, tableland and western slopes regions, with ten species (viz. *Datura stramonium, Silene gallica, Lythrum hyssopifolia, Vicia sativa, Cotula coronopifolia, Malvastrum americanum, Poa annua, Cynodon dactylon, Anagallis arvensis* and *Scleranthus annuus*) also extending further inland as far as the Far Western Plains (Harden 1990–1993). Of the four cultivated species (*Apium graveolens, Daucus carota, Fragaria vesca* and *Nicotiana tabacum)* noted by Brown, all are known to have been deliberately imported to the embryonic colony between 1786 and 1798 by Sir Joseph Banks (Frost 1993). *Apium graveolens* is now recorded as naturalised in New South Wales from only two sites (the Picton–Campbelltown area to the southwest of Sydney and from near Lake Cargelligo, Harden 1993) but is recorded currently from all Australian states except Tasmania. Whilst *Daucus carota* is widely distributed throughout southern Australia, *Fragaria vesca* is naturalised only in southeastern Queensland (D. Jones, pers. comm.). *Nicotiana tabacum* is recorded as naturalised in Queensland, New South Wales and Victoria (J. Hosking, pers. comm.).

## Discussion

It is by no means certain that all 29 species recorded by Robert Brown had naturalised by 1804. They do, however, comprise the first records of the introduced flora of New South Wales, and thus of Australia. Specht (1981) showed for four Australian States (South Australia, Victoria, New South Wales and Queensland) that the rate of increase in the number of naturalised plant species was linear with time, with an average rate of almost six species a year. To obtain that rate of increase for the Sydney district (cf. New South Wales), Specht used the numbers of naturalised species recorded by Woolls (1880), by Moore and Betche (1893), and by Beadle et al. (1972). To these may be added the published records of Anderson (1939) and of Jacobs & Pickard (1981) for New South Wales as a whole, although the former specifically excludes grasses. With a yearly increase in the number of naturalised species in New South Wales at about six species per year, Robert Brown's records for the first 16 years of settlement under-estimate the rate over the next 200 years, presumably because they were never meant to be a complete record. Currently, Hosking (pers. comm.) has records, based on vouchered herbarium specimens, for 1564 taxa as naturalised in New South Wales. We conclude that the number of naturalised species for both the Sydney region and for New South Wales has increased considerably since the first records of Robert Brown 200 years ago (Figure 1).

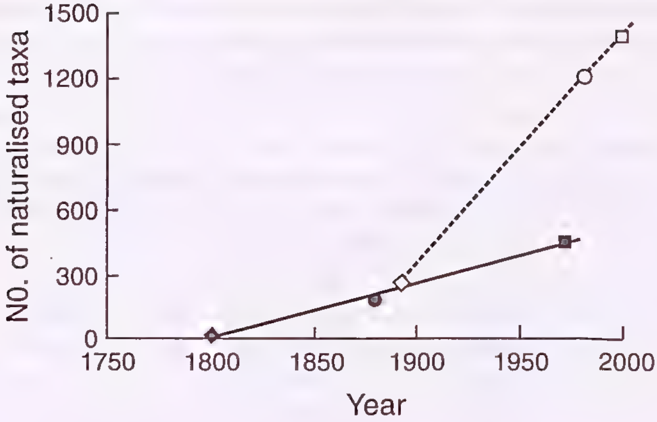

**Fig. 1.** Increases in the number of naturalised plant species in the Sydney region (solid line) and in New South Wales (dashed line), in relation to the 29 collected by Robert Brown between 1802 and 1804.

Many of the species listed by Robert Brown were also present in South Australia prior to 1855 (Kloot 1985) and at least 10 of the 29 were in Tasmania prior to 1878 (Rozefelds et al. 1999). Whether these subsequent records were as a result of relatively rapid spread from introductions to Sydney or were separate introductions is not known. What is known, however, is that all the species listed by Robert Brown are now widespread in Australia (Table 1), with the possible exception of *Fragaria vesca*. They constitute a significant 1% of the 2795 naturalised taxa that currently have vouchered specimens in Australian herbaria (J. Hosking, pers. comm.).

Some of the plants recorded by Brown as native to the Sydney region, and considered thus by Bentham (1863–1878) in his *Flora Australiensis*, may now best be regarded as introduced. Some of Brown's species are now known to have cosmopolitan distributions, e.g. *Cotula coronopifolia, Sonchus oleraceus* and *Ludwigia peploides*, and possibly also *Pavonia hastata*. One species noted by Brown as introduced to Sydney is now considered to have both indigenous and introduced populations in the Sydney region, viz. *Cynodon dactylon* (Harden 1993). The modern methods of conservation genetics and systematics may help resolve the status of some of the species recorded by Brown, either in his list (Table 1), Prodromus (Brown 1810), Appendix III in Flinders (1814), or in his diary (Moore et al. 2001).

The list of the introduced plants compiled by Robert Brown as occurring in the region of Sydney and Parramatta during his several stays in the area between 1802 and 1804 thus constitutes a valuable resource. The number of naturalised plant species in the Sydney region, as well as in New South Wales, has increased steadily since 1802 (Figure 1). Their geographic origin has changed from solely Britain to include species from many other regions and floras. The origins of the humans who have settled in the Sydney region have diversified greatly in recent years; in the same way so have the geographic origins of the weeds that interfere in some way with the activities of those many more humans living in Sydney than in the first years of settlement.

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# Cumberland Plain Woodland ecology then and now: interpretations and implications from the work of Robert Brown and others

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By the time Robert Brown visited western Sydney (1802–1805), its vegetation was already beginning to be affected by settlers' activities. The Cumberland Plain Woodland that occurred on the clay soils has now been extensively cleared and long-term management of remnants for species conservation is of high priority. Robert Brown's collections in the area, together with descriptions by Atkinson, Cunningham and other writers, provide us with valuable information on the vegetation and its floristic composition. Supported by recent site monitoring at Mount Annan Botanic Garden at Campbelltown, we interpret this information in the light of current ecological knowledge and conclude that:

- Woodland structure is variable in the short term; therefore seeking to conserve structure exactly as described in the historical literature is not necessarily appropriate.
- While the historical literature provides evidence of the broad floristic composition of the Cumberland Plain area overall, it does not provide sufficient detail on individual sites; future management of specific sites must therefore be based on current data.
- The evidence suggests relatively few species have become extinct overall, possibly because many species appear to be relatively long-lived, and have mechanisms to survive drought, fire and grazing, though not soil alteration.
- Many species, however, are now distributed patchily in localised remnants and rare species are not clustered in a predictable way; species diversity is therefore likely to be lost if further clearing of remnants occurs.

## Introduction

During his botanical collecting in the Sydney area (1802–1805) Robert Brown visited a number of sites in western Sydney. In particular he made a number of trips to the Hawkesbury River around *Greenhills* (Windsor) and the nearby Grose River, and one trip to the *Cowpastures* (Camden area). During these trips Brown would have passed through areas of Cumberland Plain Woodland which occurred extensively on the clay soils on the Wianamatta Shale geology of much of western Sydney. Even at this early stage in European settlement though, the native vegetation was already being affected by the settlers' activities — the clearing of the floodplains of the Hawkesbury River for agriculture and grazing of stock on the grassy understorey of the nearby Cumberland Plain Woodland.

Cumberland Plain Woodland once covered an estimated area of about 125 000 hectares on the clay soils of western Sydney, extending north-west to Kurrajong and south-west to Picton (National Parks and Wildlife Service 2000). It has been extensively cleared by two centuries of agriculture and urban development, and is now listed under the NSW *Threatened Species Conservation Act* as an Endangered Ecological Community. The long-term management of remnants is of high priority.

This paper looks at the species components and ecology of Cumberland Plain Woodland as described by early writers including Robert Brown, and how this compares with the composition and structure of remnants based on recent site monitoring at Mount Annan Botanic Garden at Campbelltown. We are interested in how it may have looked to the early botanical visitors, what we can infer from the 19th century record, how the ecological components interact today, and the implications for conservation and management.

## General overview of Cumberland Plain Woodland and western Sydney vegetation

The most recent view of western Sydney vegetation, that of the National Parks and Wildlife Service (2000), has been based mainly on analysis of data from remnant sites and modelling based on soil and geological associations and ecological interpretations of current plant distributions. This work confirms and indeed was largely influenced by earlier work (Benson & Howell 1990, Benson 1992) that included similar reliance on remnant vegetation, but interpreted this with more reference to historical evidence. Cumberland Plain Woodland in western Sydney is now confined to less than 10% of its original extent with most remaining as small remnants. Conservation areas include Scheyville National Park and Mulgoa Nature Reserve.

### Mount Annan Conservation Woodland site

Remnants of Cumberland Plain Woodland occur in Mount Annan Botanic Garden at Campbelltown, where they are being managed as conservation areas for the local flora and dependent fauna. Prior to its acquisition for the botanic garden in 1984 this land was part of a rural holding taken up by settlers in the early 1800s. Its past management has been patchy and has included grazing, partial clearing, cultivation and pasture improvement. The woodland remnants appear to have been least disturbed. Grazing probably stopped a year or two before the botanic garden opened in 1988.

Since 1988 we have been monitoring changes in the vegetation in one of these remnants, the Woodland Conservation Area. This particular remnant was set aside for conservation in Mount Annan Botanic Garden in 1988 and contains about 10 ha of Cumberland Plain Woodland vegetation. It has large trees of *Eucalyptus moluccana, Eucalyptus tereticornis* and *Eucalyptus crebra*, 26 native grass species in the ground cover including *Themeda australis* and species of *Aristida* and *Chloris*, and shrubs mainly of *Bursaria spinosa*. Ground cover includes both native and exotic species. In 1988 the groundcover was predominantly grassy and parts appeared to have been slashed in the previous year.

How similar is this current vegetation to what would have been the original pre–settlement vegetation of the site? This paper will discuss how difficult this is to answer and the implications for conservation management.

## Documentation of Cumberland Plain vegetation — then and now

Evidence from historical documentation is often used to interpret current vegetation issues, both broadly, e.g. the general nature of NSW pre–settlement vegetation (e.g. Benson & Redpath 1997), and locally, e.g. extent of mangroves along the Parramatta River in the 19th century (McLoughlin 2000). However it is generally not appreciated how limited is our window onto the 19th century landscape. It was not until 1900 that Joseph Maiden, Director of the then Sydney Botanic Gardens, organised the first systematic collecting of NSW plants emphasising geographical distribution. These collections of local plants were the first to be retained officially within NSW, in the National Herbarium of New South Wales, and it is only from this time that the state's botanical records begin to become comprehensive. Sources of information on plant distribution patterns in NSW prior to this are limited to the specimens and notes of botanical collectors, including well known botanists Joseph Banks, George Caley and Robert Brown, who were primarily interested in describing individual species and who sent their specimens back to Europe. Additional sources of information are the records of explorers, often with strong botanical interests, who were searching for new country. Thomas Mitchell and Allan Cunningham stand out. Their writings provide descriptions of the landscape with insights into some of the ecological processes affecting vegetation, e.g. effects of soil, flooding, fire and aboriginal impacts. Once an area had begun to be settled attention turned to the development of the land rather than its natural features.

The most convincing descriptions of the Sydney landscape are those made during the first 30 years of settlement (1788–1820), particularly the First Fleet diaries of Watkin Tench, William Bradley and John White (see Benson & Howell 1990, for examples). For the next 100 years, with the exception of descriptions of particular places (e.g. Louisa Meredith describing Homebush, William Woolls describing the Native Vineyard at Cobbitty), there are very few detailed descriptions of the natural landscape of the Sydney area. It was not until the 1920s–40s that descriptive ecology and vegetation became a serious subject for university studies e.g. the studies at Mount Wilson (e.g. Brough, McLuckie & Petrie 1924), Bulli (e.g. Davis 1936) and Ilma Pidgeon's work on Sydney vegetation (e.g. Pidgeon 1937). Of course by that time much of the pre–settlement vegetation had already been severely changed or swept away.

### Woodland structure and appearance in early colonial times

Our view of the vegetation structure of pre–settlement Cumberland Plain Woodland (as described in Benson & Howell 1990) is based on accounts such as the following.

In April 1788 Governor Phillip exploring country to the west of Parramatta and typical of the Cumberland Plain landscape reported, 'The country through which they [Phillip] travelled was singularly fine, level, or rising in small hills of a very pleasing and picturesque appearance. The soil excellent, except in a few small spots where it was stony. The trees growing at a distance of from 20 to 40 feet [6–12 m] from each other, and in general entirely free from brushwood, which was confined to the stony and barren spots.' (Phillip 1789).

In 1826 James Atkinson in his authoritative *Account of the state of agriculture & grazing in New South Wales* wrote, 'In the county of Cumberland, one immense tract of forest land extends, with little interruption, from below Windsor, on the Hawkesbury, to Appin, a distance of 50 miles; large portions of this are cleared and under cultivation, and of the remainder that is still in a state of nature, a great part is capable of much improvement. The whole of this tract, and indeed all the forest in this county, was thick forest land, covered with very heavy timber, chiefly iron and stringy bark, box, blue and other gums, and mahogany.' He had previously noted, 'It is, however, always to be understood that forest land means land more or less furnished with timber trees, and invariably covered with grass underneath, and destitute of underwood.'

Traveller Peter Cunningham wrote similarly in 1827, 'Beyond this commences a fine timbered country, perfectly clear of brush, through which you might, generally speaking, drive a gig in all directions, without any impediment in the shape of rocks, scrubs or close forest. This description of country commences beyond Parramatta on one hand, and Liverpool on the other; stretching in length south easterly obliquely towards the sea, about forty miles and varying in breadth nearly twenty.' (Cunningham 1827).

These accounts indicate a wooded community with a grassy groundcover. There is pictorial evidence confirming this. For example a painting of the Government Hut at the Cowpastures in 1804 shows the trunks of the gum trees and the generally open nature of the understorey (Figure 11 in Benson & Howell 1990).

From a range of sources it is clear that the trees were the box, ironbark and gums (*Eucalyptus moluccana, E. crebra* and *E. tereticornis)* of today's remnants; for example James Atkinson (1826) writes of, 'Box, this tree abounds in all the forest lands in the county of Cumberland and cow pasture district' and of 'Iron Bark, this tree abounds in the county of Cumberland and many other parts of the Colony.' Robert Brown reported *Themeda australis* near 'Badgerys Farm' close to Richmond.

### Woodland structure and appearance in present times

The canopy in the Woodland Conservation Area at Mount Annan includes large *Eucalyptus* trees of the species mentioned above, up to 25 m in height. These have been assumed to indicate that the site has always been a remnant of the original woodland, and that the immediate ground has not been cultivated or disturbed except by stock grazing. In 1988 with its mature eucalypt canopy and grassy groundcover the site had the appropriate structure for a woodland remnant compared with Phillip's descriptions above — large trees 20 to 40 feet apart with an open ground layer (Figure 1). During the period of study 1988–2002, however, details of the structural appearance of the remnant changed. *Bursaria* shrubs grew very vigorously to form some dense thickets, but spread only slowly laterally. Small eucalypt saplings already present in 1988 grew in size forming local cohorts of even-aged trees. Fires also produced short periods of opening up of the understorey. From 1988 until the mid 1990s there appeared to be a period of gradual death of many of the *Eucalyptus crebra* ironbark trees, probably as a result of previous stress during the major drought of the early 1980s.

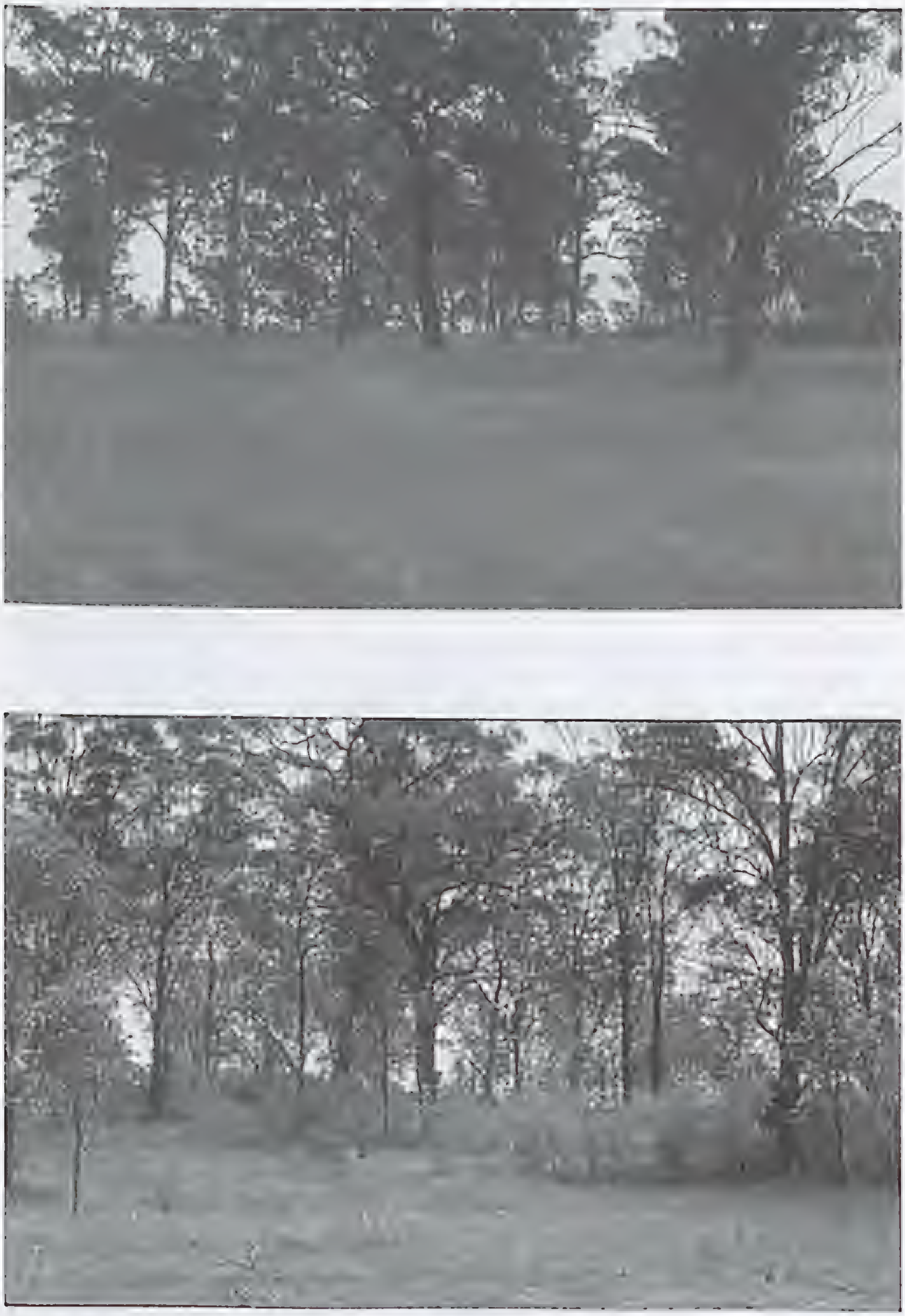

**Fig. 1.** View of the same location in Woodland Conservation Area at Mount Annan Botanic Garden in December 1988 (above) and February 2002 (below) showing change in *Bursaria* cover in particular.

Structure in Cumberland Plain Woodland is clearly subject to change over relatively short periods of time. Fire may remove ground layer and shrub foliage and create bare ground that favours seedling recruitment after rain. These impacts on structure may be relatively short-lived if good rain after fire promotes resprouting of herbs, grasses and shrubs, particularly *Bursaria,* or may be extended by frequent fires or post-fire drought. Grazing by domestic stock also affects structure of the ground layer, and we would expect such impacts to be different from those of native fauna. Drought may affect all components in different ways, but effects on trees are likely to be the most far-reaching. Given the structure found in Cumberland Plain remnants today, and the range recorded within one stand, it is an oversimplification to try to come up with an idealised model based on the historical accounts and say that the pre–settlement Cumberland Plain Woodland all looked like this.

## Current woodland floristic composition at Mount Annan

During the period 1988–2002, nearly 190 plant species have been recorded in the Woodland Conservation Area, including species present in many remnants in western Sydney. The floristic list for Mount Annan includes 126 native and 62 exotic species as currently regarded (Table 1). However, 500–600 native species occur in Cumberland Plain Woodland across western Sydney, so there is variation in composition between remnants, mostly in the ground layer. At Mount Annan there are only three canopy trees (the fourth tree species occurs as an occasional seedling), and of the dozen shrubs only two occur in any abundance, *Bursaria spinosa* and the exotic *Olea europea* subsp. *africana.* The vast majority of both natives and exotics are groundlayer species.

**Table 1.** Native and exotic species recorded in Mount Annan Woodland Conservation Area 1988–2002 showing earliest recording (natives only, excluding grasses and graminoids) of CPWL species in Sydney area.

PJ=Port Jackson, BM=Blue Mountains, *RBr*=Robert Brown

Frequency based on 1988–96 plot data, and other observations:
C=75–100%; F=50–75%; O=25–50% R=0–25% *=weed #=problem weed

| Species | Family | Historical record location/collector | Frequency 1988–96 |
|---|---|---|---|
| **Trees** | | | |
| *Brachychiton populneus* | Sterculiaceae | *J. Atkinson* | R |
| *Eucalyptus crebra* | Myrtaceae | Smithfield, *Woolls* | F |
| *Eucalyptus moluccana* | Myrtaceae | Parramatta, *Woolls* | C |
| *Eucalyptus tereticornis* | Myrtaceae | PJ, *Woolls* | C |
| **Shrubs** | | | |
| *Acacia falcata* | Fabaceae | | R |
| *Acacia implexa* | Fabaceae | PJ, *RBr* | R |
| *Acacia parramattensis* | Fabaceae | PJ-BM, *RBr* | R |
| *Bursaria spinosa* | Pittosporaceae | | C |
| *Cassinia quinquefaria* | Asteraceae | BM, *Caley* | R |
| *Cassinia uncata* | Asteraceae | | R |
| *Clerodendrum tomentosum* | Verbenaceae | | R |
| *Daviesia ulicifolia* | Fabaceae | PJ, *RBr* | R |

| **Species** | **Family** | **Historical record location/collector** | **Frequency 1988–96** |
|---|---|---|---|
| *Dodonaea viscosa* subsp. *cuneata* | Sapindaceae | PJ, *RBr* | R |
| *Exocarpos cupressiformis* | Santalaceae | PJ, *RBr* | R |
| *Indigofera australis* | Fabaceae | PJ-BM, *RBr* | R |
| *Myoporum montanum* | Myoporaceae | Cowpastures, *RBr* | R |
| *Olea europaea* subsp. *africana** | Oleaceae | | F# |
| *Ozothamnus diosmifolius* | Asteraceae | PJ-BM, *RBr* | R |
| **Vines and climbers** | | | |
| *Araujia sericifera** | Asclepiadaceae | | R |
| *Clematis aristata* | Ranunculaceae | | R |
| *Convolvulus erubescens* | Convolvulaceae | PJ-BM, *RBr* | R |
| *Parsonsia straminea* | Apocynaceae | | R |
| **Groundlayer**<br>**Ferns** | | | |
| *Asplenium flabellifolium* | Aspleniaceae | PJ-BM, *RBr* | R |
| *Cheilanthes distans* | Sinopteridaceae | | R |
| *Cheilanthes sieberi* | Sinopteridaceae | PJ, *RBr* | F |
| *Pellaea falcata* | Sinopteridaceae | PJ-BM, *RBr* | R |
| **Herbs**<br>**Asteraceae – Daisy family** | | | |
| *Brachycome angustifolia* | Asteraceae | Goulburn, *Cunningham* | R |
| *Calotis lappulacea* | Asteraceae | PJ-BM, *RBr* | R |
| *Carthamus lanatus** | Asteraceae | | R |
| *Cirsium vulgare** | Asteraceae | | O |
| *Conyza albida** | Asteraceae | | R |
| *Cotula australis* | Asteraceae | PJ-BM, *RBr* | R |
| *Cymbonotus lawsonianus* | Asteraceae | PJ, *RBr* | R |
| *Euchiton gymnocephalus* | Asteraceae | | R |
| *Euchiton* sp. *E (=aff. argentifolium)* | Asteraceae | | R |
| *Facelis retusa** | Asteraceae | | R |
| *Gamochaeta americana** | Asteraceae | | R |
| *Hypochaeris radicata** | Asteraceae | | F |
| *Hypochoeris microcephala* var. *albiflora** | Asteraceae | | R |
| *Lagenifera gracilis* | Asteraceae | PJ-BM, *RBr* | R |
| *Leontodon taraxicoides** | Asteraceae | | R |
| *Rhodanthe anthemoides* | Asteraceae | | R |
| *Senecio madagascariensis** | Asteraceae | | C |
| *Senecio quadridentatus* | Asteraceae | PJ-BM, *Sieber* | R |
| *Solenogyne bellioides* | Asteraceae | PJ, *RBr* | R |
| *Solenogyne dominii* | Asteraceae | | R |
| *Soliva sessilis** | Asteraceae | | R |
| *Sonchus oleraceus* | Asteraceae | PJ, *RBr* | F |
| *Taraxicum officinale** | Asteraceae | | R |
| *Vernonia cinerea* | Asteraceae | PJ-BM, *Woolls* | R |
| *Vittadinia cuneata* var. *cuneata* | Asteraceae | PJ, *RBr* | R |
| **Fabaceae – Pea family** | | | |
| *Desmodium brachypodum* | Fabaceae | PJ-BM, *RBr* | R |
| *Desmodium varians* | Fabaceae | PJ, *Banks*, *RBr* | F |

| Species | Family | Historical record location/collector | Frequency 1988–96 |
|---|---|---|---|
| *Glycine tabacina* | Fabaceae | PJ-BM, *RBr* | C |
| *Hardenbergia violacea* | Fabaceae | PJ-BM, *RBr* | R |
| *Lotus australis* | Fabaceae | Hunter River, *RBr* | R |
| *Medicago lupulina** | Fabaceae | | R |
| *Trifolium campestre** | Fabaceae | | R |
| *Trifolium glomeratum** | Fabaceae | | R |
| *Trifolium striatum** | Fabaceae | | O |
| *Zornia dictyocarpa* | Fabaceae | PJ, *RBr* | R |
| **Other Dicot Herbs** | | | |
| *Ajuga australis* | Lamiaceae | PJ-BM, *RBr* | R |
| *Alternanthera* sp. *A* | Amaranthaceae | | R |
| *Anagallis arvensis** | Primulaceae | | F |
| *Asperula conferta* | Rubiaceae | Parramatta, *Woolls* | C |
| *Atriplex semibaccata* | Chenopodiaceae | PJ, *RBr* | R |
| *Brunoniella australis* | Acanthaceae | PJ, *RBr* | C |
| *Centaurium tenuiflorum** | Gentianaceae | | R |
| *Chamaesyce drummondii* | Euphorbiaceae | | R |
| *Ciclospermum leptophyllum** | Apiaceae | | O |
| *Crassula sieberiana* | Aizoaceae | | R |
| *Daucus glochidiatus* | Apiaceae | PJ-BM, *Sieber,Cunningham* | R |
| *Datura stramonium** | Solanaceae | | R |
| *Dichondra repens* | Convolvulaceae | Parramatta, *RBr* | C |
| *Echium plantagineum** | Boraginaceae | | R |
| *Einadia hastata* | Chenopodiaceae | PJ, *RBr* | O |
| *Einadia nutans* subsp. *linifolia* | Chenopodiaceae | | O |
| *Eremophila debilis* | Myoporaceae | PJ-BM, *RBr* | R |
| *Erodium crinitum* | Geraniaceae | | R |
| *Galium propinquum* | Rubiaceae | PJ-BM, *RBr* | R |
| *Geranium solanderi* | Geraniaceae | PJ, *RBr* | C |
| *Goodenia hederacea* | Goodeniaceae | PJ-BM, *RBr* | R |
| *Heliotropium amplexicaule** | Boraginaceae | | R |
| *Hypericum gramineum* | Hypericaceae | PJ, *RBr* | R |
| *Hypericum perforatum** | Hypericaceae | | R |
| *Lepidium africanum** | Brassicaceae | | O |
| *Lepidium bonariense** | Brassicaceae | | R |
| *Linum trigynum** | Linaceae | | R |
| *Lythrum hyssopifolia* | Lythraceae | PJ, *Herb, Hooker* | R |
| *Mentha satureioides* | Lamiaceae | PJ-BM, *RBr* | O |
| *Modiola caroliniana** | Malvaceae | | R |
| *Opercularia varia* | Rubiaceae | PJ, *RBr* | R |
| *Oxalis perennans* | Oxalidaceae | PJ, *Beckler* | C |
| *Paronychia brasiliana** | Caryophyllaceae | | R |
| *Petrorhagia nanteuilii** | Caryophyllaceae | | R |
| *Phyllanthus virgatus* | Euphorbiaceae | | R |
| *Pimelea spicata* | Thymelaeaceae | PJ & neighbouring dist. *RBr* | R |
| *Plantago gaudichaudii* | Plantaginaceae | | O |

| **Species** | **Family** | **Historical record location/collector** | **Frequency 1988–96** |
|---|---|---|---|
| *Plantago lanceolata** | Plantaginaceae | | C |
| *Plantago myosuros** | Plantaginaceae | | R |
| *Plectranthus parviflorus* | Lamiaceae | PJ-BM, *RBr* | R |
| *Polycarpon tetraphyllum** | Caryophyllaceae | | R |
| *Polygala japonica* | Polygalaceae | Botany Bay, *RBr* | R |
| *Poranthera microphylla* | Euphorbiaceae | PJ-BM, *RBr* | R |
| *Ranunculus lappaceus* | Ranunculaceae | PJ & interior, *RBr* | R |
| *Ranunculus sessiliflorus* | Ranunculaceae | | R |
| *Richardia stellaris** | Rubiaceae | | F |
| *Rosa rubiginosa** | Rosaceae | | R |
| *Rubus parvifolius* | Rosaceae | | R |
| *Rumex brownii* | Polygonaceae | PJ, *RBr* | R |
| *Scutellaria humilis* | Lamiaceae | PJ, *RBr* | R |
| *Sherardia arvensis** | Rubiaceae | | R |
| *Sida corrugata* | Malvaceae | Hawkesbury River, *RBr* | F |
| *Sida rhombifolia** | Malvaceae | | F |
| *Silene gallica* var. *gallica** | Caryophyllaceae | | R |
| *Solanum chenopodioides** | Solanaceae | | R |
| *Solanum cinereum* | Solanaceae | Grose River, *RBr* | R |
| *Solanum prinophyllum* | Solanaceae | PJ, *RBr* | R |
| *Stachys arvensis** | Lamiaceae | | R |
| *Stackhousia viminea* | Stackhousiaceae | PJ, *RBr* | R |
| *Stellaria media** | Caryophyllaceae | | R |
| *Verbascum virgatum** | Scrophulariaceae | | R |
| *Verbena bonariensis** | Verbenaceae | | R |
| *Verbena litoralis** | Verbenaceae | | R |
| *Verbena officinalis** | Verbenaceae | | R |
| *Verbena rigida** | Verbenaceae | | R |
| *Veronica plebeia* | Scrophulaceae | PJ-BM, *RBr* | O |
| *Wahlenbergia communis* | Campanulaceae | | R |
| *Wahlenbergia gracilis* | Campanulaceae | PJ-BM, *RBr* | O |
| *Wahlenbergia stricta* | Campanulaceae | | R |
| **Groundlayer – Grasses** | | | |
| *Agrostis avenacea* | Poaceae | | R |
| *Aristida ramosa* | Poaceae | | C |
| *Aristida vagans* | Poaceae | | R |
| *Austrodanthonia bipartita* | Poaceae | | R |
| *Austrodanthonia pilosa* | Poaceae | | C |
| *Austrodanthonia racemosa* var. *obtusata* | Poaceae | | R |
| *Austrodanthonia tenuior* | Poaceae | | R |
| *Bothriochloa macra* | Poaceae | | O |
| *Briza maxima** | Poaceae | | R |
| *Briza minor** | Poaceae | | R |
| *Briza subaristata** | Poaceae | | R |
| *Bromus molliformis** | Poaceae | | O |
| *Bromus unioloides** | Poaceae | | R |

| **Species** | **Family** | **Historical record location/collector** | **Frequency 1988–96** |
|---|---|---|---|
| *Chloris truncata* | Poaceae | | O |
| *Chloris ventricosa* | Poaceae | | C |
| *Cymbopogon refractus* | Poaceae | | R |
| *Cynodon dactylon** | Poaceae | | O |
| *Dicanthium sericeum* | Poaceae | | R |
| *Dichelachne micrantha* | Poaceae | | C |
| *Echinopogon ovatus* | Poaceae | | O |
| *Elymus scaber* | Poaceae | | R |
| *Eragrostis molybdea* | Poaceae | | R |
| *Eragrostis trachycarpa* | Poaceae | | R |
| *Eriochloa pseudoacrotricha* | Poaceae | | R |
| *Eriochloa crus-galli** | Poaceae | | R |
| *Lolium perenne** | Poaceae | | R |
| *Microlaena stipoides* | Poaceae | | C |
| *Nassella neesiana** | Poaceae | | R# |
| *Oplismenus imbecillis* | Poaceae | | R |
| *Panicum effusum* | Poaceae | | R |
| *Paspalidium distans* | Poaceae | | R |
| *Paspalum dilatatum** | Poaceae | | C |
| *Poa labillardieri* | Poaceae | | F |
| *Setaria geniculata** | Poaceae | | O |
| *Sorghum leiocladum* | Poaceae | | R |
| *Sporobolus africanus** | Poaceae | | R |
| *Sporobolus creber* | Poaceae | | F |
| *Themeda australis* | Poaceae | | F |
| *Vulpia bromoides** | Poaceae | | O |
| **Groundlayer – Graminoids** | | | |
| *Arthropodium milleflorum* | Anthericaceae | | R |
| *Caesia parviflora* var. *vittata* | Anthericaceae | | R |
| *Carex breviculmis* | Cyperaceae | | R |
| *Carex inversa* | Cyperaceae | | C |
| *Cyperus eragrostis** | Cyperaceae | | R |
| *Cyperus gracilis* | Cyperaceae | | O |
| *Dianella longifolia* | Phormiaceae | | R |
| *Eleocharis cylindrostachys* | Cyperaceae | | R |
| *Fimbristylis dichotoma* | Cyperaceae | | R |
| *Hypoxis hygrometrica* | Hypoxidaceae | | R |
| *Juncus prismatocarpus* | Juncaceae | | R |
| *Juncus subsecundus* | Juncaceae | | R |
| *Lomandra filiformis* subsp. *filiformis* | Lomandraceae | | C |
| *Lomandra multiflora* | Lomandraceae | | R |
| *Pterostylis curta* | Orchidaceae | | R |
| *Romulea rosea** | Iridaceae | | R |
| *Scleria mackaviensis* | Cyperaceae | | R |
| *Sisyrinchium* sp. A *(sensu micranthum)** | Iridaceae | | R |
| *Tricoryne elatior* | Anthericaceae | | O |

Typical sandstone woodland has a much higher proportion of native shrub species, as shown by the comparison in Table 2. Early botanists such as Allan Cunningham report that the floristic composition of western Sydney, principally the Cumberland Plain Woodland, was quite different from that of the typical Sydney coastal sandstone flora with its conspicuous shrubby component and its predominance of families Fabaceae, Proteaceae and Rutaceae.

**Table 2.** Number of native and exotic species by life-form in Cumberland Plain Woodland at Mount Annan, and comparison with woodland on sandstone; A. 12 plots, 0.3 ha, Woodland Conservation Area, Mount Annan Botanic Garden, B. 2 sites, 0.2 ha, Ku-ring-gai Chase NP.

| **Number of species in Woodland Conservation Area, Mount Annan Botanic Garden (10 ha)** | | | | | |
|---|---|---|---|---|---|
| | **Trees** | **Shrubs** | **Groundplants** | **Climbers** | **Total** |
| Natives | 4 | 13 | 106 | 3 | 126 |
| Exotics | | 1 | 60 | 1 | 62 |
| **Number of native species by life-form** | | | | | |
| Woodland on shale^A | 2 | 2 | 78 | - | 82 |
| Woodland on sandstone^B | 9 | 66 | 68 | 5 | 148 |

Current species abundance (frequency at recording plots 1988–96 and in the woodland generally) is also shown (Table 1). The only common shrub is *Bursaria spinosa* while the common groundcover species are the natives *Themeda australis, Brunoniella australis, Glycine tabacina, Asperula conferta, Dichondra repens, Geranium solanderi, Oxalis perennans, Aristida ramosa, Austrodanthonia pilosa, Chloris ventricosa, Dichelacne micrantha, Microlaena stipoides, Carex inversa* and *Lomandra filiformis.* Common exotics are *Senecio madagascariensis, Plantago lanceolata* and *Paspalum dilatatum.*

## Were these the species in the woodland here in 1788?

Although Banks and Solander made the first plant collections in the Sydney area in 1770, their collections were from a limited area and remained undescribed for many years. Robert Brown's 1802–05 collections however were used in contemporary publications and many of his records are included in Bentham's *Flora Australiensis.* Using this and Brown's recently available *Diary* (Vallance et al. 2001) we have been able to confirm that most of our Cumberland Plain Woodland species at Mount Annan were reported in the Sydney area in the early years of the 19th century (Table 1). We found that 62 of 84 of the woodland's dicotyledonous species are known to have been collected by early colonial botanists, that is, 70% of the dicot species excluding some problematic groups such as *Gnaphalium* and *Vittadinia* where old names are difficult to correlate with collections. These early collections include 50 by Brown (annotated as either 'Port Jackson' or 'Port Jackson to the Blue Mountains'), with an additional two of the species being collected by George Caley and one by Joseph Banks (in 1770). A similar result appears to apply to the monocotyledons but our unfamiliarity with grass synonymy makes tracing old names here difficult. Given that Brown did not travel much beyond the Hawkesbury and Nepean Rivers it is evident that the majority of our woodland species were undoubtedly part of the Sydney area flora in 1802–05 and are highly likely to have been present in the pre–settlement Cumberland Plain Woodland of western Sydney.

Brown also recognised that the native landscape was changing as a result of European settlement and that non-native species were being introduced into the farmed and settled areas, and along roads. Of his list of 29 weeds recorded for the Sydney area (1802–05) (see Richard Groves' paper, page 623) *Cynodon dactylon, Silene gallica, Stachys arvensis, Lolium perenne, Anagallis arvensis* and *Briza minor* occur in the Mount Annan Woodland. Interestingly 19th century botanists regarded *Sonchus oleraceus* also now occurring in our woodland, as a cosmopolitan and native species — Allan Cunningham records it in a list of native species on the Cudgegong River in 1822 in box woodland with *Themeda australis*, country similar ecologically to Cumberland Plain Woodland. In view of this evidence we include *Sonchus* as a native and *Cynodon* as an exotic in our tables. As a final note we record that *Ludwigia peploides* subsp. *montevidensis,* now found in floodplain wetlands along the Hawkesbury River is clearly native and not an introduced species (cf. Dalby 2002). Brown records it 'at the margin of Yellowmundy's Lagoon', now Yarramundi Lagoon near Richmond in his diary on 14th September 1804 (Vallance et al. 2001).

Assuming that these species were part of the pre–settlement Cumberland Plain Woodland can we get a better idea of the original abundance of species? Brown does not include descriptions of the landscape nor much on the habitats of individual species or their abundance — after all he was a taxonomist focussed solely on listing and describing the plants, appropriate for a first encounter with a largely unknown flora. However from other writers particularly botanist/explorer Allan Cunningham, we can get snippets of information.

Allan Cunningham's Journal (quoted in Lee 1925), '22/10/1817 At the invitation of a friend I went out to his farm near Liverpool, ... *Daviesia corymbosa*, very frequent in the forest land, in flower. ... In the forest land I gathered seeds of a *Helichrysum*, leaves linear, flowers white. Like other farms in the neighbourhood it is overrun with the *Bursaria spinosa*, now in fruit.

19/10/1819 ... To the southward of Liverpool the country is an open forest-land of common Eucalypti, in which *Exocarpus cupressiformis*, and the papilionaceaous tree *Jacksonia scoparia*, at this period laden with yellow flowers, are very conspicuous. *Pimelea spicata* and *P. glauca* of Mr. Brown; a small *Daviesia* with cordate leaves (*D. squarrosa*, Smith); with a *Helichrysum*, allied to *H. papillosum* and prevalent in this description of country. ... In situations on the roadside, more or less subject to inundation, a delicate, tufted small *Lobelia (L. inundata)* is in flower, and *Ruellia australis* [*Brunoniella australis*] is common in grassy dry spots, decorating our path throughout this day's route.'

Although fragmentary, these notes indicate some of current woodland species that were relatively conspicuous in the open-forest country in the Liverpool area early in the 19th century. Some species are common in our woodland today, e.g. *Bursaria spinosa* and *Brunonella australis*, others also occur in our woodland but are rare *Pimelea spicata, Exocarpos cupressiformis* and *Helichrysum*. *Pimelea glauca* has been found in another remnant about 1 km away.

## How much of the presettlement flora has been lost?

Settlement of the Cumberland Plain took place from the early 1800s as domestic stock were moved in. During the next hundred years grazing was widespread while clearing for cultivation was extensive in many areas. In the 20th century urban development expanded into many areas. Our site at Mount Annan is probably typical of many Cumberland Plain remnants. Over the past 200 years it is likely to have suffered from a range of impacts: grazing by domestic stock (sheep, cattle, horses) and rabbits, partial clearing, cultivation for pasture improvement, deliberate introduction of pasture, accidental introduction of weeds, and altered fire regimes (though not necessarily all parts of the area were impacted to the same degree).

The list of native plant species still occurring in western Sydney in the 1990s has over 1200 species (James et al. 1999), though this study includes species on the sandstone margin lands. There are probably about 500–600 species that occur on the shale areas and associated alluvial areas that support Cumberland Plain Woodland (Benson & McDougall 1991). This is still a considerably rich flora for an area that has undergone a considerable amount of environmental disturbance. Of the 1200 species however about 700 species are listed as regionally vulnerable in western Sydney. Many are now rare. For example for western Sydney, 502 species were recorded from 5 or fewer sites.

Given the extent of disturbance one would expect that many native species would have been lost from the woodland flora as a whole. However the only western Sydney species to be nationally listed as extinct in recent years is *Hypsela sessiliflora* which was probably a component of River-flat Forest rather than Cumberland Plain Woodland. Interestingly one of the few collections of *Hypsela* was by Ferdinand *Bauer* who was collecting for Brown. *Hypsela* was rediscovered recently near Penrith.

**Table 3.** Species recorded in Camden/Campbelltown in the 19th Century, most likely as part of Cumberland Plain Woodland, but now regarded as Extinct or Rare.

**Extinct species**

*Thesium australe*: recorded Cow Pastures 1803, mentioned by Cunningham at Emu Plains (7/9/1817) and Parramatta (6/9/1818) now extinct in western Sydney (James et al. 1999)

*Swainsona monticola*: recorded Cow Pastures 1802, Georges River 1910, Camden 1965 now extinct in western Sydney (James et al. 1999).

**Rare species**

*Pimelea spicata:* recorded Liverpool 1819

*Pimelea glauca:* recorded Liverpool 1819, Camden 1990s

*Myoporum montanum:* recorded Cow Pastures, R. Brown (21/10/1803)

*Velleia paradoxa*: recorded Campbelltown 1893 but not collected in Sydney area since 1945 (Benson & McDougall 1997

*Vittadinia tenuissima*: recorded Mount Hunter, R. Brown (23/10/1803)

Our list of species recorded from the Camden/Campbelltown area in the 19th century and now regarded as Extinct in western Sydney (Table 3) is very short, two species *Thesium australe* and *Swainsona monticola* (though bear in mind that there is very little documentation from the 19th century). Additionally about 150 regionally vulnerable species have been recently recorded in Cumberland Plain Woodland in the Camden and Campbelltown local government areas (James et al. 1999). A number of these occur in our study area in the Woodland Conservation Area, including *Pimelea spicata, Rhodanthe anthemoides, Sorghum leiocladum, Calotis lappulacea, Vernonia cinerea* and *Ranunculus lappaceus.*

Were these species rare in the presettlement vegetation? *Thesium* appears to have been relatively common. Cunningham (in the limited documentation we have access to) refers to *Thesium* in several places in western Sydney. He also refers to *Pimelea glauca* and *Pimelea spicata* with apparent familiarity suggesting these species may have once been more common in Cumberland Plain Woodland. There are no references to *Swainsona monticola* between 1802 and 1965 (after which its only occurrence is destroyed by lawnmowing). *Myoporum montanum* is mainly confined to hilly country around Razorback and may have always been restricted though relatively common in this area (Razorback because of its steeper topography and sandstone bands within the Wianamattta strata has a number of species, particularly dry rainforest species, not found elsewhere in western Sydney).

Given the magnitude of change in western Sydney, intuitively one would think that many species went extinct early after settlement. However, we have not been able to find evidence that many Cumberland Plain Woodland species have completely disappeared. *Thesium* and *Swainsona* are the only clearcut examples. Did many species go extinct before they were ever recorded? In our view Brown's highly regarded collecting record suggests that this is unlikely. Our reading of Brown is that he was a dedicated and methodical collector, working with the intention of recording all of the plants that he possibly could. As soon as he had collected a new species and made notes on it, he could dismiss it from his mind, and turn to the next species. He was not interested in whether species were common or rare, or how they related to the landscape, things that modern ecologists would spend a lot of time sampling. As a result he could move through the district very efficiently, recording all the species. With a collector's eye for detail however he may have surveyed as many different local habitat types as possible, and multiple visits at different seasons would have allowed him to pick up additional species. As a result we are confident he would have recorded a very high percentage of the flora of the areas he visited. In the 1970s, using a similar traditional approach, Royal Botanic Gardens' collector Bob Coveny was able to compile very extensive lists of plant species for Royal National Park from a limited number of trips covering the major habitats of the Park. It was rare to find a species that Bob had not found there.

In addition, although Brown only sampled limited transects through the Cumberland Plain Woodland, the areas appear to have been relatively continuous with few geographic barriers and little natural fragmentation. Creeks provide the main local variation. In contrast, for example, coastal rainforest, where new species are still not infrequently discovered, e.g. *Eidothea hardeniana* in 2000 (Weston & Kooyman 2002), is naturally dissected, occurring as discontinuous, isolated pockets with relatively large distances between them. There are many isolated occurrences of species and many species with low frequency.

## Species longevity and mechanisms for persistence

In our view therefore the floristic list as recorded by James et al. (1999) probably reflects the original presettlement flora though the local distribution and frequencies of many species have changed as a result of the fragmentation of woodland remnants that recent development and clearing has produced. Given the types of disturbance over the last 200 years, are there any characteristics of the flora that may have helped species to survive better than we may have expected?

### Estimated lifespans

General observations on the canopy eucalypts suggest they are relatively long-lived and the presence of large individuals generally indicates minimal disturbance to the immediate surrounding soil surface. Trying to establish lifespan ages for groundlayer species is more difficult. Having observed the Cumberland Plain Woodland flora at Mount Annan for almost 20 years we have tabulated our views (Table 4) on the lifespan classes for the native and exotic species there. About 25% of the native species are very long-lived perennials (mainly trees) or indefinite perenials (e.g. rhizomatous sedges). We think that such species may survive for centuries. A further 25% we regard as long perennial (5–50 years), though we may be being conservative and these may be longer-lived than we think. Many of these species have thick fleshy roots and die back above ground during dry seasons, responding quickly when conditions improve. About 50% are annuals and short perennials though many of these may be able to live up to 5 years. Most of the grasses are in this group. In contrast about 80% of the exotic species fall into the short-lived class. (Note that differences in total species number between Table 1 and Tables 4 and 5 reflect lack of observations of uncommon species.)

**Table 4.** Estimated lifespan classes for native and exotic species in Cumberland Plain Woodland at Mount Annan

| | **Annual 1 year** | **Biennial 2 years** | **Short perennial 1–5 years** | **Long perennial 5–20 years** | **Very long perennial 50–200 yrs** | **Indefinite perennial indeterminate yrs** |
|---|---|---|---|---|---|---|
| Native species 104 | 7 | | 44 | 27 | 5 | 20 |
| Exotic species 59 | 26 | 7 | 14 | 6 | 1 | 5 |

### Resprouting after drought and fire

Table 5 shows that about 25% of the native flora is capable of local vegetative expansion, that is that under suitable conditions they are able to expand their local populations by spreading by rhizomes, root suckers, etc. This allows quick recovery after dry periods, intensive grazing, fire or other physical above ground disturbances. Few exotic species have this capability though the few that do include the more successful weeds e.g. *Hypericum perforatum, Nassella neesiana.*

**Table 5.** Number of native and exotic species capable of local vegetative expansion

| | Capable of local vegetative expansion | Not capable |
|---|---|---|
| Native species 104 | 23 | 81 |
| Exotic species 59 | 4 | 55 |

Fire is a natural component of the ecology of Cumberland Plain Woodland. Fire responses observed for native and exotic species at Mount Annan are shown in Table 6. Nearly half of the native species are known to resprout, the large number of unknowns being due to the fact that only a small part of the woodland has been burnt during our studies. It is suspected that the majority of these 'unknown' species will also be able to resprout after fire. One native species, *Dodonaea viscosa* subsp. *cuneata*, and one weed, *Araujia sericifera* showed both responses, apparently depending on fire intensity and age of plant.

**Table 6.** Fire responses observed in Cumberland Plain Woodland at Mount Annan for native and exotic species.

| | Resprout | Killed | Not known* |
|---|---|---|---|
| Native species 126 | 63 | 3 | 61 |
| Exotic species 62 | 12 | 3 | 48 |

One of the main attributes of many of these Cumberland Plain Woodland species is long term persistence at a site. Cumberland Plain Woodland is now restricted to small remnants scattered across western Sydney. Most species-rich remnants occur at sites where there is still a natural old soil surface that has not been destroyed by ploughing or filling. The occurrence of a few old trees generally supports the view that these are relict sites that have not been ploughed. Many Cumberland Plain Woodland species are long-lived, and capable of withstanding harsh conditions, particularly drought. The frequency of fleshy storage roots in the Cumberland Plain Woodland flora, (and we would think it is a more frequent character than in the nearby Sandstone flora), suggests that drought survivorship has been a most important factor in the longterm survival of the flora. Indeed many of the Cumberland Plain Woodland species are able to survive under a much lower rainfall than the 750 mm pa of the Campbelltown area. Some of the frequent Cumberland Plain Woodland species including *Aristida ramosa, Brunoniella australis, Dichondra repens, Geranium solanderi, Tricoryne elatior* and *Sida corrugata*, also grow in woodland with a rainfall of 350–500 mm in the Forbes–Lake Cargelligo area, for example (Sivertsen & Metcalfe 1995).

Plant responses to drought that allow dying back and resprouting, also enable plants to survive fire, especially for long-lived plants species that do not require frequent seedling recruitment. These attributes may explain how the Cumberland Plain Woodland flora has been able to survive the recent european period with its stock and rabbit grazing, though not of course clearing and cultivation of the land itself. It may also explain how it survived aboriginal burning regimes. Indeed it is tempting to go back further to the period of the last glaciation 18 000 years BP when rainfall was perhaps half of today's. We would suggest that during those conditions the western Sydney landscape had many of the groundlayer Cumberland Plain Woodland species there today, though the eucalypt canopy was probably absent.

### Localised versus widespread distributions

A final point. We pointed out above that the pre–settlement distribution of Cumberland Plain Woodland species and individuals across the gently undulating shale landscape was probably more even and homogeneous than perhaps in more naturally isolated communities such as rainforest. Many species are common and frequent in Cumberland Plain Woodland remnants from Windsor to Picton. Many species are now very infrequent, but apart from clustering of dry rainforest on the steeper topography of Razorback Range, there does not appear to be any obvious clustering together of rare species in particular areas or habitats at the regional scale. At the local scale in the Mount Annan woodland we have patches of a number of regionally rare species including *Pimelea spicata, Rhodanthe anthemoides, Sorghum leiocladum* and *Ranunculus lappaceus.*

Apart from a tendency for some species to favour moister sites, it is difficult to understand why these uncommon species stay relatively confined to the small patches they now occupy (we have observed some of these species closely for up to 14 years). Our thinking is that many of these now rare species were widespread and some possibly common through the pre–settlement Cumberland Plain Woodland landscape, but have been lost in most areas due to fragmentation or subtle habitat changes resulting from rural and urban development. For example, some species may have relatively limited dispersal abilities and once lost from a site are unable to recolonise from a distance. Others may have been linked to animal pollinators or seed dispersers no longer present in woodland remnants. Our current research on life cycles of woodland species is aimed at replacing some of these speculations with facts.

Indeed if the pre–settlement Cumberland Plain Woodland flora was distributed relatively evenly, as we suggest, it is likely that Brown and his collecting colleagues would have noted the vast majority of this flora — remember that they walked or rode through many kilometres of Cumberland Plain Woodland between Parramatta and the Grose or the Cowpastures. It appears to us unlikely therefore that there were a lot of Cumberland Plain Woodland species that were made extinct by European settlement, before they were able to be recorded by science.

## Conclusions and implications for conservation and management

### Implications from historical data

Primary historical documentation on Sydney vegetation pre-1900 is very limited. It consists of records of plant specimens collected for describing species, and generally not collected once the species was known, and the accounts of explorers and travellers, of varying reliability. Much of the information is either mostly generalised or very site specific.

The available data indicates that the pre–settlement Cumberland Plain Woodland was dominated by a tree canopy with an open grassy understorey with some localised shrubby areas. Individual Cumberland Plain Woodland sites still contain these components, though our experience over the last 14 years shows that these structural components may change relatively quickly in response to changes in grazing, fire and disturbance. For management purposes it is pointless to try to achieve a supposed historical ideal appearance — rather, structure will be the result of treatments aimed to maintain species composition, which may mean maintaining both shrubby and grassy areas as well perhaps as some treeless areas.

Similarly, our knowledge of the local distribution and abundance of species in the 19th century is very limited, and will always remains so (we suspect that our memories of the 20th century landscapes will similarly fade). In terms of species abundance at a particular site, depending on the species, patterns have probably changed from pre-1788 abundances, as a result of sifting by past management practices and current ecological conditions. Because of the very limited nature of the historic accounts, it is not clear whether many species have been lost from the original Cumberland Plain Woodland complement (i.e. became extinct before they could be recorded). We suggest that the original collections, substantially by Robert Brown, were relatively comprehensive and that few 'uncollected' species have been lost.

A surprisingly large number of species still survive overall. In our view therefore the floristic lists recorded in the 1990s (James 1997, James et al. 1999) probably reflect the composition of the original pre–settlement flora, though the regional distribution and local frequencies of many species have changed (and there have been a few introductions from western parts of the state with stock movement).

## Maintaining long term diversity

Because of its limitations historical documentation is best used to provide ideas and hypotheses, not to justify management decisions. Our primary guide to plant distributions must remain our currently documented patterns, and our guide to managing vegetation must remain the current ecological responses of the species themselves, as evidenced in current research.

Individual Cumberland Plain remnants may contain a substantial number of native species; that these are clearly native to these sites, is supported by the limited historical documentation available. In terms of biodiversity conservation our aims for each remnant should be to ensure the long-term survival of all native species present at a particular site. Depending on the individual reserve, ecological conditions can be changed to favour selected species or groups of species but this should done in a way that ensures total species composition at each site remains in the long term.

Additional species should not be introduced, unless there is evidence that these come from the same original provenance and there is a particular case to reintroduce them (i.e. needed for ecological processes). Generally however such additions are not necessary, could be done at any time in the future, and detract from the task of managing those species that are already present. With our increasing technical ability to explore the genetic variation within species, it is important that as much of the pre–settlement distribution patterns are maintained at this stage.

Exotic weed species are now rapidly changing most Cumberland Plain Woodland remnants and pose a major problem for management. Interestingly native Cumberland Plain Woodland plants may be able to survive drought, fire and periodic grazing but they may be less well equipped to survive periods of shading and may be vulnerable to crowding out by vigorous growing exotic species such as *Olea europea* subsp. *africana* and *Nassella neesiana.*

### Maintaining rarer species

While some common species will occur at almost every site, a considerable number of species are now rare and confined to a few sites, some of which are localised to areas of perhaps only a few square metres. Reasons for occurrence at these sites may be due to historical chance such as land subdivisions, cemeteries, road verges rather than these sites providing particular habitat, soil requirements etc. However individual plants may persist for a long time despite past and present conditions that are not necessarily in their favour. Many Cumberland Plain Woodland species have demonstrated considerable long-term persistence through periods of drought, fire and grazing, but are less able to tolerate major soil disturbance and competition from exotic species. Many Cumberland Plain Woodland species may also have limited distance dispersal abilities for propagules, though they may successfully persist at the local scale.

With our present state of knowledge it is difficult to predict which sites will have unusual species, i.e. it is not clear why they occur where they do. Indeed, unless the variability between sites and the value of small remnants are recognised, the main era of species loss from Western Sydney may be about to begin, as the last surviving remnants in many areas are threatened with destruction.

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# Rarity, rare plant species and the New South Wales *Threatened Species Conservation Act* — conservation opportunities and challenges

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Rare species have long exerted a particular fascination for many botanists. The reasons for this are discussed, as are the justifications for the scientific study of rare and threatened species. A high proportion of the threatened species currently on the Schedules of threatened species in New South Wales were first collected by the earliest botanical explorers. Possible reasons for their success in finding rare species are speculated upon.

Legislative requirements for the identification of threatened species have arisen under the Biodiversity Convention, and the particular regime established by the New South Wales *Threatened Species Conservation Act 1995* is described. Features of the plants currently included on the New South Wales Schedules are discussed and the question as to whether they are affected by a variety of recording biases is examined. The consequences of listing for the long term conservation of threatened species are explored.

## Introduction

Rare species, or at least some of them, have a high profile today. They are at the forefront in many conservation battles, and large amounts of money, both public and private, are expended on their protection and management. In the popular media it would seem that rare species, collectively, are a synonym for biodiversity, and that biodiversity conservation is to be achieved by protecting rare species (or at least those with the good fortune to be charismatic, cuddly or otherwise appealing to humans).

Concern for the welfare of some rare species has been expressed by an eccentric minority for many years, but has become a popular movement only in the last fifty years or so, stimulated perhaps by increased awareness of the scale of human impacts on the environment and the educative role of the media, particularly television. However, interest in rare species, as objects to be collected because they are rare, has a very long history, predating scientific exploration or cataloguing of the environment.

The occasion of the Robert Brown 200 symposium provided an opportunity to reflect on a number of issues related to the conservation of rare plant species. For many of these issues there are still more questions than answers, and in relation to conservation there is a need for greater debate about objectives and resource allocation.

Scientists will need to be participants in, or even initiators of, debate. In this paper many questions are posed, but few answered. I hope that these unanswered questions will promote further research, and contribute to the agenda for a debate on conservation strategy.

## Robert Brown and his contemporaries

The Schedules (the lists of threatened species) of the New South Wales *Threatened Species Conservation Act 1995* contain a surprising number of taxa originally described and collected by Robert Brown during his time in Australia (1801–1805). Collections show that Brown and his contemporaries made many findings of rare species. Even more Mueller taxa (Ferdinand von Mueller 1825–1896) are on the Schedules — many of which were also first found in the primary exploration phase.

Given the richness and diversity of the Australian flora, and its novelty to northern European eyes, how were these pioneers so successful in finding rarities when everything about them was new?

At the beginning of the nineteenth century the British flora was still being explored. While many of the rarities in lowland habitats had long been known (Marren 1999), the upland flora was still being discovered (Raven & Walters 1956). Brown's mentor, George Don ('the acute Mr. G. Don', according to Hooker 1821), was one of the most successful finders of new species in Scotland. Don and his contemporaries had a keen eye for plants and an ability to discover new localities, and it is not unreasonable to think that Brown would have showed similar enthusiasm and skills. Although their search strategies were never documented it seems likely that they had clear ideas of what would constitute 'good ground'. In the context of Scotland, with predominantly base-poor acid soils, many of the famed botanical locations were on 'better' soils or rocks. This was before the development of geological science, so guidance from geological maps was not available. The concept of geological mapping was still several decades away (Winchester 2001), but most of the suitable sites are 'greener' than the surroundings. Such visible evidence can still be useful to identify sites for searching (Ratcliffe 2000). Cliff ledges were also likely to be free from grazing pressure.

In the Australian context such a search image would not have been so immediately profitable, although cliffs and boulder fields would provide refugia for fire sensitive species. The fire prone nature of the Australian landscape and the diversity of plant responses to fire would have been extremely foreign to British experience, so the importance of refugia would not have been recognised. Their early success in finding what are now threatened species could reflect declines in species abundance since European settlement. This may be the case for some of the Cumberland Plain taxa now rare and threatened, but in other cases there is little evidence for either previous greater abundance or more extensive distribution. Some of the plants Brown recorded (such as *Thesium australe*, see Benson & Howell in accompanying paper page 631) are reasonably cryptic and would rarely be noticed today unless specifically sought out. The feats of the early botanical collectors are even more remarkable when it is remembered that there were no floras; information on what had been previously seen (and hence, what had not, and was thus 'new') had to be carried in the head. Collectors had to be sparing in what was collected because of limitations on transport and scarcity of resources such as paper for drying specimens.

Early collectors had upbringings that exposed them to nature on a regular basis; collecting a whole range of natural history objects in childhood was encouraged. Most skilled field naturalists will have assembled diverse collections (Ratcliffe 2000) — today collecting is politically incorrect and in many cases clearly undesirable (egg collecting etc.). However, we no longer encourage careful observation, and despite the need to provide education on conservation, we have perhaps cut off one of the main avenues by which appreciation for nature and science is gained.

However they were acquired, Brown possessed finely honed skills of observation, interpretation and memory which few develop today.

## The importance of rarity

### Why are we attracted to rare species?

By modern standards Brown and his colleagues were not conservationists (although I suspect were they alive today, they would be), but they certainly were interested in rarity. Dictionaries provide a range of meanings for 'rare'. Some, such as 'undercooked', are not relevant to this discussion; the majority relate to the spatial (and/or temporal) distribution of abundance of things (in the present context, individuals of a species). These explain what rarity is, but do not indicate why humans might be so interested in rare species. Another definition perhaps provides the clue, 'Unusual in respect of some good quality: remarkably good or fine' (Oxford English Dictionary). Species which, because of their distribution, are regarded as rare tend automatically to be assumed 'remarkably good or fine', and it is this characteristic that is a major part of the attraction which rare species have long exerted. For some it is the thrill, or even the glory, of finding rare species (on occasion, possibly, even to the extent of inducing scientific fraud, Sabbagh 1999), for others the interest is more commercial, collecting rare species for trade (although such activity has long been illegal in many jurisdictions).

Interest in rare species because they 'are remarkably good or fine' might serve to attract criticism in the form of recital of Lord Rutherford's aphorism, 'All science is either physics or stamp collecting'. Rare plant hunting could be seen as the botanical equivalent of stamp collecting or train spotting, activities appropriate as hobbies, but not a proper focus for professional research. Can research on rare species be justified?

### Why conserve rare species?

The biodiversity paradigm has been accepted as the basis for conservation by both the public and politicians. A number of justifications for biodiversity conservation have been developed, but the scientific underpinning of these arguments is still being built. If investment in biodiversity conservation is to be sustained then research will be required to test current assumptions and counter skeptics. Rare species are a component of biodiversity, so research on rare species will necessarily be part of the research needed to understand and manage biodiversity as a whole.

There is a global interest in species as genetic resources, potential sources of new products which may be valuable pharmaceuticals or of other industrial use (see, for example, Tooth 2001). Any species, including rare ones, may prove to be useful. In the popular media this finds expression in statements suggesting that species need to be conserved because they may contain the cure for cancer or HIV/AIDS. There is no doubt that many drugs and other chemicals have been discovered in organisms, and that many more will be discovered in the future. Some indeed may be found in rare species. Nevertheless, the success rate in screening programs is low, either because many species do not contain useful compounds, or because we cannot as yet see uses for the compound they do contain.

Other species may be valued not for what they contain but for what they are. Some rare species may produce flowers of exceptional beauty, or possess other features of horticultural interest. Production of plants for gardens is a major international business, and rare species in the wild play a significant role in the trade. Research on propagation and other aspects of their biology will be required to take advantage of the horticultural potential of these species.

Most of the reasons given above, both for conserving and studying rare species, are based on perceived utilitarian values. However, there are many who believe that species should be conserved for reasons other than being useful to humans (Ehrenfeld 1978, Mann & Plummer 1995). Such beliefs underlie much conservation legislation and public expectations for the management of biodiversity. Scientific exploration of the biology of rare species will be needed to manage these species so that society's aspirations can be met.

## How many species need to be lost before changes occur to ecosystems?

An important argument in favour of conserving biodiversity is the dependence of human existence on ecosystem services (Daily 1997). Our survival depends on the maintenance of healthy, functioning ecosystems. The question is, how many species are required for ecosystem functioning?

This is unknown for any ecosystem but two hypotheses have been proposed. The rivet hypothesis (an analogy between species and the rivets in an aircraft wing, Ehrlich & Ehrlich 1981) suggests that, while a small number of species could be lost without effect, once a certain (but unknown) number had gone structural integrity would be lost. The particular identity of the species is not relevant, it is simply the number lost which is responsible for collapse.

The alternative view is that there is considerable redundancy amongst the species in a community, but that certain species are crucial to maintaining ecosystem integrity. Unfortunately we are not necessarily able to predict which these species are. Top carnivores are possible candidates, and for energetic reasons, these are also likely to be rare (Colinvaux 1980). We can envisage that plant species such as figs in rainforest may also provide ecosystem support. For many rare plants, individually small and with limited populations, the possibility that they may be essential components of ecosystems depends on the scale of ecosystem considered. As each plant species may support its own unique assemblage of fauna (insects, nematodes etc.) every plant species may therefore be considered as the basis of an ecosystem — the loss of any plant species results in the loss of an ecosystem. However, at the larger spatial scale of what is conventionally recognised as a plant community, it is difficult to envisage that loss of a single rare species would have a significant impact on community function. The relationship between species richness of communities and functional attributes such as productivity or resilience has been debated for a long time, but there are still too few data to reach generalised conclusions (Tilman 1997).

Extinction is not a new process — species have been going extinct almost since the origin of life. Species which are rare today may have been more abundant in the past. The fossil record in northern Europe, for example, shows that during the Pleistocene there has been a series of glacial–interglacial cycles; although there are differences in the behaviour of individual taxa between cycles, there is a repeating pattern by which species which were common and widespread under late glacial/early post glacial environmental conditions become rare and local in late interglacials (West 1970, Goodwin 1975). In Australia the glacial/interglacial cycle was reflected in changes between greater aridity during glacial times and times with greater extent of mesic communities in interglacial. Rainforest was restricted to limited refugia during the glacials (Webb & Tracey 1981, Adam 1992, Bowman 2000), although the possible extent of rainforest on what is now continental shelf remains to be explored.

Present environments are ephemeral, environmental change a certainty. Some species rare today may be the common species of tomorrow. From a conservation perspective protecting rare species is about maintaining options for the future. For science the tasks are to understand environmental change and species' responses and to improve predictions.

## Rarity in time and space

It is general observation that when a census of an area is made there are a few abundant species and many more which at that locality and at that time would be regarded as rare (Preston 1948, Colinvaux 1980). This finding appears to hold across a range of ecosystems (even though total species richness varies between ecosystems) and for the total biota as well as particular taxonomic subsets.

**Are species which are rare in particular localities rare throughout their geographic range, or are they rare only at some localities and abundant elsewhere (Schoener 1987)?** Species in the first category, exhibiting 'suffusive rarity' in Schoener's (1987) terminology could be called rare without qualification, and are those which are the focus of conservation concern. Although reliable data are hard to come by for most taxonomic groups it would appear that suffusive rarities are a rare type of rarity, many more species are what Schoener (1987) has called 'diffusive rarities', only rare in parts of their range. Murray et al. (1999), term the categories 'everywhere sparse' and 'somewhere abundant'.

There have been a number of proposals to recognise categories of rare species on the basis of their geographical and/or ecological (habitat) distribution (see Ayensu 1981, Given 1981, Rabinowitz 1981). The most widely adopted scheme, that of Rabinowitz (1981), is a typology of results (the existing verifiable distribution) and not one of causes. Species which are today narrowly restricted endemics may be relics of once wider distributions, newly evolved species, or stable species with highly specialised habitat requirements.

At any one site the relative abundance of species may change over time for a variety of reasons. While there is rightly concern over the numerous and rapid changes (both decreases and increases) which can be attributed to human activities we must remember that there are other causes of change over time. In some cases the fluctuations over time may be more apparent than real, if the presence of a propagule bank is acknowledged. However, from a practical perspective examination of the soil seed banks is unlikely to be part of routine ecological survey.

Some temporal change may be easily predictable (for example seasonal changes) but other cases are far less so. There are many plant species (and associated fauna) which are restricted to particular stages of succession or to ephemeral or post-disturbance habitats. Such species pose interesting management problems. At any one time they may be abundant at a few localities, but are generally rare; at any one place they may be abundant at one time but otherwise apparently absent. Over a region, and over a long period, the population may be relatively stable, although its distribution may move in a kaleidoscopic way across the landscape.

However, as natural bushland becomes increasingly fragmented the probability that a species will be represented in a particular fragment declines. If a species requires a particular form of disturbance then it may be necessary to mimic natural disturbance of the species if it is to be retained in a reserve. This is the practice in a number of European reserves (see for example Frost 1981), but would such practices be supported by the conservation movement in Australia? Recently management regimes involving manipulation of grazing to maintain grasslands have been introduced in a number of Australian reserves (Low 2002), indicating an evolution of policy by agencies, if not yet by the public. A NSW example of a species with infrequent appearance following disturbance is *Olearia flocktonii*. An American example of an endangered butterfly dependent on a single host plant species in turn dependent on a particular post fire vegetation successional stage is *Lycaeides melissa samuelis* dependent on *Lupinus perennis* (Mann & Plummer 1995).

## The NSW *Threatened Species Conservation Act 1995* (*TSC Act*)

One of the consequences of countries becoming parties to the Biodiversity Convention has been extensive revision of existing legislation and the introduction of new laws; Australia is no exception to this activity (compare Prineas 1989 with NEDON 2000).

In New South Wales the relevant new legislation is the *Threatened Species Conservation Act 1995* (*TSC Act*) which commenced on 1 January 1996. The first objective of the *TSC Act* (s3 (a) is, 'to conserve biological diversity and promote ecologically sustainable development' — the other objectives (s 3(b) – 3(f) deal with threatened species, populations and ecological communities. Concentrating attention on threatened species reflects public concern but tends to obscure the importance of taking a holistic view of biodiversity. The *TSC Act* substantially increases the protection available to plants across the State, whereas, outside of national parks and nature reserves, previous legislation concentrated on a subset of the vertebrate fauna (Prineas 1989). Threatened components of marine vegetation (algae, sea grasses and mangroves) are listed under provisions of the *Fisheries Management Act 1994* —

compared with legislative models elsewhere, that in New South Wales is unusual in that it divides the identification of threatened biota between two Acts.

If threatened species are to be protected by legislation it is necessary for mechanisms to be established for their identification and listing. For taxa covered by the NSW *Threatened Species Conservation Act* the process of listing on the Schedules is carried out by an independent Scientific Committee. This is unusual in that, in most other jurisdictions, the listing process is the responsibility of a Minister, often acting on the advice of a committee of relevant experts. There has been substantial criticism of the independence of the Scientific Committee, it being argued that decisions should be made by a Minister answerable to Parliament (and hence the people of NSW). (See, for example Hansard record of debates, *Threatened Species Conservation Amendment Bill* 2002.)

The need for accountability is seen as important because of perceptions of the impacts of listing on property rights. However, it is important to recognise that the executive role of the Scientific Committee is restricted to determining whether or not a particular species (or population, ecological community or threatening process) satisfies the criteria for listing established (by Parliament) in the Act. Assessing the case for listing may require professional judgment, but essentially is one of reaching a decision about an objective fact — a species is either threatened or it is not, and that status should not depend on whether or not particular interests may be upset by listing. Listing may have consequences for land use and development, and these may have considerable economic and social impacts. However, under current legislation, presence of a threatened species is not a bar to development; it is merely one factor to be considered when possible approval is being contemplated. New South Wales legislation contains numerous provisions for other social and economic issues to be raised in relation to development and resource management.

Any person may nominate to add to or remove from or amend the Schedules of the *TSC Act*. This permits the very detailed knowledge in the community to be utilised in their development. A variety of criteria have been proposed for the assessment of the status of threatened species, but the Scientific Committee must be satisfied that the criteria specified in the *TSC Act* have been met. Application of the IUCN scheme (Keith 1998, Keith et al. 1997, Keith et al. 2000) may provide very useful guidance, but is not determinative.

## What is the appropriate spatial context for listing?

It could be argued that species should be assessed for listing on the basis of their entire geographic range, regardless of whether this encompasses more than one jurisdiction. In most cases, however, legislation requires that species be assessed on the basis of their occurrence within the area subject to a particular jurisdiction. This creates a category of threatened species referred to by Rabinowitz (1981) and Cropper (1993) as 'pseudorare' — species given formal threatened status in part of the range although not regarded as rare or threatened elsewhere. Thus a number of species, not endemic to the State, are listed as threatened on the schedules of the *TSC Act* but are not listed nationally under the *Environment Protection and Biodiversity Conservation Act 1999*. This has attracted criticism, particularly in the case when the only NSW occurrences are very close to the State border.

Recognition of 'pseudorare' species can be justified on several grounds. One of the levels of biodiversity is genetic: disjunct populations, or those at the limit of a species' range may be genetically distinct and thus worthy of recognition (the same argument is also applicable to the recognition of endangered populations under the TSCA within NSW). Populations at the limit of a species' range may be more susceptible to a range of threats than those at the centre of its distribution.

Pseudorare species can act as flagship species for conservation. Local communities can take pride in what is special in their neighbourhood, and through promoting the conservation of individual species can advance the protection of the environment more generally. Few of the rare or threatened species in Britain are endemic and most are more abundant elsewhere in Europe (Marren 1999), but are nevertheless afforded legislative protection and are the subject of considerable conservation efforts. The long history of detailed recording represented in the tradition of county floras (Marren 1999, for examples see Graham 1988, Halliday 1997) means that within Britain locally rare species attract considerable attention.

The identification of locally rare species as objects of community pride may through protection of habitat, serve to advance the cause of conservation. Each local council in NSW is now obliged to report regularly on the State of the Environment within its area of jurisdiction. The resources available to councils vary considerably, and large urban councils may have more specialist officers devoted to State of the Environment reporting than rural councils with tiny populations and rating bases. This disparity of effort is a cause of concern, especially as local government has a key role to play in off-reserve conservation and may be required (*Threatened Species Conservation Act* s70(2)) to report on actions taken to implement recovery plans for threatened species. However, while there is considerable variation between councils in the adequacy of State of the Environment reports, the reporting requirements do mean that all councils are (if but slowly) becoming better informed as to the nature and importance of natural resources within their area. It may be appropriate for councils to consider developing lists of local species of conservation concern as part of the State of the Environment requirements, as a means of heightening local community awareness of conservation issues. (The parallel development of both state and local lists is not without precedence, and already occurs in the listing of heritage items and in relation to noxious weeds where some weeds are listed only in particular local government areas.)

## *We've got a little list...* The Schedules of the NSW *Threatened Species Conservation Act*

The *Threatened Species Conservation Act* has in its Schedules, a large, and growing, list of threatened plant species (Endangered species, populations and ecological communities on Schedule 1, Vulnerable species on Schedule 2).

**Are the Schedules comprehensive?** The answer is clearly, no. The *TSC Act* permits any taxa to be considered for listing and takes a broad view of 'plant'. Nevertheless the Schedules are overwhelmingly dominated by the higher or vascular plants.

Currently the only non-vascular plants are a small number of basidiomycete fungi. There are no listed bryophytes, lichens (although an endangered ecological community defined by lichens has been listed) or freshwater algae (marine algae are listed under the *Fisheries Management Act*). It is highly likely that there are species in these groups which would satisfy the criteria for listing, but it is highly unlikely that in the foreseeable future, there will be more than a handful accorded threatened status.

The small number of listed non-vascular plants arises for two reasons. Firstly, the basic taxonomic research to enable catalogues of these taxa lags behind that of the higher plants, and, largely as a consequence we lack the basic data on which to make assessments. Secondly, if species have not previously been recognised it is unlikely that there will be evidence of declines in distribution or abundance. Similar lack of data is likely to constrain the growth of lists of threatened invertebrate species. The acceptance of the biodiversity paradigm has raised awareness of the importance of non-vascular plants and invertebrates, but has not yet led to substantial investment in improving our knowledge of these groups. Listing of individual non-vascular species as threatened will be important symbolically, giving formal recognition to the broad concept of biodiversity, but is not in itself likely to substantially improve the conservation status of other cryptogam or invertebrates. Measures to improve protection of habitat, or recognition of endangered communities of which cryptogams and invertebrates are essential components, even if not identified as such in the community diagnosis, are urgently required, as well as increased understanding by habitat managers of the conservation needs of the 'less obvious' components of the biota.

**If the lists are very far from being comprehensive for non-vascular plants, can at least we make claim for them being comprehensive for the vascular flora?** Any list could only be comprehensive at any one point in time — changing threats will mean that taxa not currently threatened could decline to threatened status in the future, and the process of assessment must be a continuing one. Likewise, some currently threatened species may, either through deliberate management or otherwise, increase so as to be no longer threatened; in the near future it seems probable that more species will be added to schedules than removed. Even taken as today's snapshot the vascular plant schedules may not be comprehensive but be influenced by both taxonomic and geographic biases (see Burgman 2002, and discussion below).

**Are the species on the Schedules threatened?** The process of nomination and assessment of potential listings guarantees that, in the opinion of the Scientific Committee, the species on the Schedules satisfy the criteria for being threatened. The nomination procedure also provides an 'appeal' mechanism in that as well as nominations for addition, cases can also be made for amendment (for example to move a species from endangered to vulnerable or vice-versa) or removal.

There is a tendency in compiling lists of threatened species for there to be a bias in favour of species with restricted distributions, rather than species which while rare are geographically widespread (Burgman 2002). This tendency is also evident in the NSW list.

**Geographically restricted species certainly satisfy definitions of 'rare' but are they necessarily 'threatened'?** As an extreme example the Wollemi Pine *Wollemia nobilis* is listed as Endangered on Schedule 1 of the *Threatened Species Conservation Act*. The area of occupancy is very limited; the number of individuals is small (and the number of genetic individuals even smaller) — by any criteria it is an extremely rare species. However all known, wild occurrences are within a National Park.

Given that conservation is the prime objective of management of national parks why is *Wollemia nobilis* regarded as 'Endangered', a category which implies serious risk of extinction? *Wollemia nobilis* is clearly a great survivor. Its very discovery has, paradoxically, exposed it to greater risk. Although the location of the wild population has not been disclosed, and legal access is strictly controlled there is a risk of illegal visitation which would result in introduction of pathogens, illegal collecting and malicious damage. The nature of the location is such that constant surveillance, as has been applied to sites of some conservation icons overseas, is not an economically viable management option. Additionally, beyond deliberate harm, any small and geographically restricted population is at risk from environmental and demographic stochasticity. A single event could result in extinction. While management may be able to do little to alter the level of risk (and arguably should not even attempt to) species with very small populations in limited areas undoubtedly satisfy the criteria for listing as endangered under both the *TSC Act* and IUCN criteria.

More problematic is our ability to use existing criteria to list common and abundant species when a new threat emerges. For example it could have been argued that the American Chestnut *Castanea dentata* was doomed when its pathogen *Endothia parasitica* first reached America, even though at that time it was a major forest canopy tree over a wide area. The current criteria could not easily be used to list equivalent species, but by the time the decline was such as to trigger assessment the opportunity for effective control and recovery may have been lost.

## Some interesting features of the current NSW *Threatened Species Conservation Act* Schedules

At present more than 9% of the State's vascular flora has been listed as either Endangered or Vulnerable in the Schedules of the *TSC Act*. These threatened species are not a random 9% sample of the flora. Mokany and Adam (2000) analysed threatened flora, and showed significant patterns in the geographic, community and taxonomic distribution of threatened species.

### Are some geographic regions over-represented?

Geographically the highest numbers (and significantly more than expected) of threatened plant species were found in the North Coast and Central Coast Botanical Divisions (using the Anderson 1947 regionalisation of the flora). The North Coast encompasses some of the greatest topographic and ecological diversity in the State, and has experienced severe habitat disturbance (coastal sandmining, coastal development, clearance of the Big Scrub for agricultural development) and includes, on the continental scale, an important biogeographic boundary zone, the MacPherson-Macleay overlap (Burbidge 1960). The presence of large number of threatened species, many of them restricted endemics, is not surprising. The Central Coast has a very rich and diverse flora, and for the past 200 years has been the site of the growth of the most extensive conurbation in the country. Again the high concentration of threatened species is not surprising. What is surprising is the low proportion of threatened species on the South West Slopes, a region where a great deal of the original woodland vegetation has been cleared for agriculture. Is the small number of threatened species 'real', or does it reflect inadequacy of exploration and recording, so that losses and declines have been underestimated?

Since the commencement of the *TSC Act* in 1996 a large number of nominations to list plant species as threatened have been made. Nominations arise from a diversity of sources, but many are from individual members of the public. The majority of additions to the Schedules arising from nominations have been for the North and Central Coasts, the regions which already had the largest number of threatened species. These regions are those where, as a result of continuing urban development, threats to biodiversity are high and very obvious at the individual site level. They are also regions with a large, concerned and informed population, so that the large number of nominations is not surprising. The low number of nominations from west of the Divide, where threats may be more diffuse, and population density lower, may not however, reflect the real status of the flora. The nomination process cannot be relied upon as the only source of information about likely threatened species, and must be complemented by directed surveys.

The Mokany and Adam (2000) analysis of the distribution of threatened species by vegetation community was constrained by the broad nature of the communities for which data were available. Large numbers of threatened species were found in rainforest, sclerophyll forest and sclerophyll woodlands, with higher than expected numbers in woodland. This result is not surprising given that woodland has borne the brunt of agricultural development, but until recently woodlands have not been a focus for conservation action and opportunities for conserving what little of the habitat remains are limited.

## Are some taxa over-represented?

Taxonomically some taxa, notably Myrtaceae, Proteaceae, *Grevillea* and *Zieria*, contain more threatened species than would be expected, while other families such as Asteraceae, Poaceae and Cyperaceae are under-represented in the schedules. Are these differences real or artefacts?

There is variation geographically in reports of the taxonomic distribution of threatened species (Edwards & Westoby 2000). In the United States, for example, Asteraceae comprise a high proportion of recognised threatened species (Morse 1996). However, Poaceae and Cyperaceae would appear to be generally under-represented (Edwards & Westoby 2000). Grasses and sedges are likely to be under-recorded in many surveys (or recorded at a higher taxonomic level so that determination of the presence of threatened species is not possible); the small number of threatened species may be more apparent than real. In the Australian context Asteraceae are probably under-recorded, 'daisies' being regarded as 'difficult' by many ecologists. Additionally, Asteraceae are well represented in semi-arid regions, where there is considerable, climatically driven, temporal variation in abundance and identifiability, so that recording requires good seasons. Much more field work will be required to determine whether or not more Asteraceae are threatened in NSW.

Edwards and Westoby (2000) analysed the taxonomic distribution of rarity in the Australian flora. The analysis dealt with rare rather than threatened flora so is not strictly comparable with the NSW analysis of Mokany and Adam (2000). The Edwards and Westoby (2000) analysis is strongly influenced, in the case of temperate taxa, by the very large number of rare species in south west Western Australia. Nevertheless, there are interesting similarities and differences between the threatened flora profile in NSW and that of the rare flora of the whole continent. Families with significantly more species than expected in both State and continent list are Myrtaceae, Proteaceae and Rutaceae, significantly under represented in both lists are Cyperaceae and Poaceae. Over-represented nationally, but not in NSW, are Brassicaceae, Epacridaceae, Orchidaceae and Rhamnaceae; over-represented in NSW, but not nationally are Casuarinaceae and Lamiaceae.

### Are some lifeforms under-represented?

Statistically fewer threatened species than expected are herbs; does this reflect biased recording (and the difficulty of identifying many trees in dry times) or is this a special feature of the Australian flora?

### Do rare plants share attributes?

There have been many studies which have sought relationships between plant attributes and species rarity and abundance (see Murray et al. 2002). Given the importance of fire in the Australian environment it would be particularly interesting to relate threat status to fire response. Much of the relevant data probably exists, but has yet to be appropriately synthesised.

Unfortunately, most traits have only been investigated in one study and many studies have examined only a few species. Consequently demonstration of generalised relationships is difficult (Murray et al. 2002). Most traits displayed different relationships with rarity in different studies. This suggests that generalised management prescriptions may not be attainable, and also that predicting the characteristics of rare species will be difficult. There is unlikely to be a model rare plant — rather every species will be different.

### Are habitats evenly represented?

It would be fascinating to explore correlates of threat status in much greater detail, but appropriate ecological data are not yet available. A relationship between substrate (soils and geology) and rarity has frequently been identified (Marren 1999). Many rare and geographically restricted species are extreme habitat specialists, often being restricted to particular geological outcrops (Keith & Sanders 1990). It is highly likely that this is the case in New South Wales, but the data recorded in the Flora or on herbarium labels is frequently inadequate to address the question. Globally, serpentine outcrops support highly distinctive vegetation and many locally endemic species (Brooks 1987); NSW serpentine outcrops are known to be botanically interesting, but are still not sufficiently recorded to be identifiable as threatened species hot spots.

There are hotspots with concentrations of rare or threatened species. These may be distinctive habitats occupied by extreme habitat specialists, for example, serpentine outcrops (Brooks 1987), or sites which for reasons of geological history have provided refugia (Pigott and Walters 1954). Such places become sites of botanical pilgrimage — but while the concentration of interest leads to further increases in the number of known rare species (often extending to other groups such as bryophytes and lichens) there is a danger that this will discourage exploration of what are perceived as unprofitable sites, so that the distinctiveness of the hotspots may be exaggerated.

Unfortunately there are few data on the occurrence of threatened species in listed endangered ecological communities, but endangered communities will not necessarily have large numbers of, or even any, endangered species. An ecological community is an assemblage that is endangered, although most species characteristic of a particular community will not themselves be threatened. In the Mokany and Adam (2000) analysis this was well shown by wetlands which had significantly under-representation of threatened species. Wetland plant communities are often relatively species poor and many wetland plant species have very wide geographic distributions. Wetland species are habitat specialists but few satisfy the criteria to be listed as threatened. This does not in any way reduce the importance of wetlands in the landscape or provide justification for lessening the range of measures in place to protect and conserve wetlands.

Not all rare species occur in concentrations. Some species are found at single, otherwise undistinguished sites, others (the sparse everywhere group of Murray et al. 1999) may be scattered widely. As Birks (1972) pointed out, understanding the distribution of these rare species presents, 'an inscrutable problem, for one has to explain not so much why a plant grows where it does, as why it is missing from so many other places that are apparently equally suitable. When all the obvious possibilities have been considered, the distribution of many species remains inadequately explained in terms of gross environmental factors.' Predictive modelling of the distribution of these species on the basis of current ecological knowledge is unlikely to be profitable.

## What are the consequences of listing?

Preparing lists of threatened species is an interesting exercise, as is exploring correlates of rarity, but does it have practical consequences for biodiversity conservation? The *Threatened Species Conservation Act* provides for both reactive and proactive responses to listing.

The presence of threatened species is a matter for consideration when development applications are before councils or other consent authorities (Conway 2002). However, it is only one of many issues which may be taken into account, and the legislation provides no indication that threatened species will be given greater weight than any other matter. In the six years of the *TSC Act's* operation very few developments have been totally rejected because of the potential impacts on threatened species (Debus 2002) although many more have been modified.

Listing, and the associated publicity, serves to attract criticism from those fearful of consequences, but listing also serves to increase general community awareness of biodiversity and conservation issues. One of the more controversial endangered ecological community listings has been that of the Cumberland Plain Woodland (also listed as endangered by the Commonwealth). This is a community which would have been familiar to Robert Brown and his contemporaries, and which has been extensively cleared. Unlike communities on sandstone around Sydney, which changed directly from bush to housing, the Cumberland Plain was the early agricultural base of the developing colony, so that many of the fragments have been isolated for over 150 years. Today, with the continued population growth of Sydney, both agricultural land and bush remnants are under threat of development. The listing of much of the native vegetation as endangered ecological communities has forced planning authorities to give greater consideration to protection and management of surviving bush, but it is to be regretted that it required the *TSC Act* to bring about a change in approach and perspective. Appropriate planning in earlier decades could have resulted in the retention of ecologically functional landscapes and possibly prevented the need to list communities as endangered.

A major potential danger of a regime in which biodiversity considerations in the planning process are driven by threatened species legislation is that it will fail to take an holistic approach. As Little (2001) has argued, 'biodiversity is more encompassing than just threatened species. What is needed is a wider biodiversity framework aimed at conserving and managing ecosystem processes across the landscape, and within which threatened species issues fit'. Such a paradigm shift has yet to overtake most land management authorities and agencies who continue to take a narrowly reductionist approach to their responsibilities.

## Recovery Planning

Pro-active approaches under the *TSC Act* are mandated by the requirements for production of Recovery Plans and Threat Abatement Plans. In my view the terminology 'Recovery Plan' has the potential to create unrealistic expectations amongst both bureaucrats and the general public as to the content of the plans: a more neutral 'Conservation Plan' would have been preferable.

The *TSC Act* states that the object of a recovery plan is, 'to promote the recovery of the threatened species, population or ecological community to which it relates to a position of viability in nature'. *Ex situ* conservation, but loss in the wild, would not be considered a successful outcome. Under the United States *Endangered Species Act* 1973 recovery is defined as the point, 'at which the measures provided pursuant to this Act are no longer necessary'; the objective of recovery planning in the USA is, therefore, delisting. The range of activities which might be considered as promoting recovery is not discussed in the NSW *TSC Act*, nor is 'viable' defined, so it is unclear that delisting is seen as the necessary indication of success of the recovery planning process.

## To make rare plants common?

In 1981 John Harper suggested that there was sufficient ecological knowledge available for natural resource managers to make rare plants common, and asked which rare species should be candidates for being made common. At the time there was little enthusiasm amongst his audience for such a prospect, reflecting that rarity *per se* is viewed as a positive attribute — a common species somehow does not have the same appeal as a rare one.

However, if Harper were to ask the same question of an Australian audience today, would the response be the same? I suspect not — rather there would be a significant minority, and perhaps even a majority, who would be advocates of intervention to increase population numbers of threatened species. In part this would be because the term 'recovery plan' implies a return to a previous state, and thus an increase in either abundance or extent of distribution.

Harper's (1981) optimism was perhaps premature. While some species could be made common we know so little about the biology of many rare species that we do not know why they are rare, let alone how they could be increased. But why is the concept of actively promoting an increase in abundance contestable?

If the idea is to 'recover' the population to some previous level of abundance or distribution, how do we determine what the appropriate level would be? For locally endemic habitat specialists there may not be suitable unoccupied habitat so that the option for increasing wild populations may not exist. Would it be appropriate to attempt to establish populations of such species outside their natural range? What might be the consequences of transplanting on genetic diversity?

Every case needs to be examined on its merits. There may be some cases where heroic attempts at 'recovery' and translocation are justified, but equally there will be others where it is inappropriate. In the case of *Wollemia* should we aim for a return to Mesozoic levels of abundance? If so, what species would need to be displaced to make this possible? Given that the existing population is 'viable in nature' at present and, provided the habitat is not degraded, there is no compelling case for field translocation. This argument would require us to recognize that a population may be viable but still at risk from environmental or demographic stochasticity, and therefore still warrant listing.

Recovery plans are yet to be produced for the majority of species listed on the schedules of the *TSC Act*. Plan production is expensive and time consuming, and there is a danger that the process could divert resources away from management. I share Marren's (2001) concern that concentration on the details of individual species may lead us to take our eye off the bigger picture and fail to address the factors impacting not just on selected threatened species but biodiversity on the whole. Habitat protection and reduction in key threatening processes would lead to better conservation outcomes, and be more economical. The recovery planning process has the potential to obscure the necessity for holistic approaches. The lists of threatened species are, as argued previously, merely the tip of the iceberg. There are many more taxa which could be listed if only data were available. Conservation management should, as far as is possible, attempt to improve the status of all threatened species, not just currently listed ones.

### Given limited resources is it possible or desirable to prepare recovery plans for all species?

This is a controversial topic, but some argue that triage is essential (see for example Possingham in Carlisle 2002). Inevitably there will be prioritisation of the order of plan production. Under the *TSC Act* (s 58 (2)) highest priority is given to species which are listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act*. However, a strong case could be made that at least some vulnerable species should be given high priority so that steps can be taken to prevent their status worsening to endangered.

The effect of resource limitation will be to make meeting the timetable for recovery planning specified in the legislation difficult and the prioritisation process will result in anomalies. However, to determine that some listed species are beyond redemption, and thus never produce a recovery plan, would be a bold decision. Particularly for perennial long lived plants, long term survival, despite very low population size, may be possible provided the habitat is not destroyed. Such species require, at least, conservation plans which protect habitat. Some endangered species will be close to the end of their geological lifespan and extinction will be inevitable, other species with currently small populations might undergo resurgence under future environmental conditions. Currently we could not with confidence predict which species fall into which category.

## Concluding discussion

Given the nature of threats to biodiversity it is likely that more species will continue to be added to the Schedules of the NSW *Threatened Species Conservation Act* and similar legislation elsewhere. Implementation of recovery plans may halt declines but is unlikely to result in improved status for most threatened species.

On the other hand experience teaches us that many rare plants have remarkable survival abilities. This is demonstrated in New South Wales by many species including *Eidothea hardeniana*, *Gentiana wingecarribiensis*, *Kippistia suaedifolia* and *Wollemia nobilis* and in Britain by the many examples of species which have been known from the same localities for hundreds of years (Raven & Walters 1956, Marren 1999). The most important task is to prevent the loss of habitat of rare species. Some habitat protection can be achieved through general measures (controls on vegetation clearing, for example) but in many cases protection of rare species habitat will require site specific measures.

The first step is to know where species are. This will require much greater attention to recording localities and maintaining data-bases than has been the case to date. Unfortunately, there is no equivalent in Australia to the Biological Records Centre in the United Kingdom, nor atlases with the level of detail of Preston et al. (2002). Achieving such an end will demand that we harness the skills of the many amateur botanists and plant enthusiasts in the population. I recognise the problems in such exercises identified by Underwood and Chapman (2002), and that observers (professional and amateur) will have biases in what they record. Nevertheless with appropriate review and quality control procedures, valuable data can be collected, as is demonstrated by the range of atlases available in Britain and Europe.

We will never have complete catalogues; even in the well studied British Isles new, non-adventive species are still being found (and not just segregates of *Rubus* or *Hieracium*) (Marren 1999). One of the most recent, *Gagea bohemica* is instructive. This occurs at a well known rare plants locality, but eluded detection for so long because its flowering season was well before that of any of the other notable species at the site (Preston et al. 2002). After all, why would anyone visit the site when there was nothing to see? If we are to better understand our biota, we must challenge such accepted wisdom.

In two hundred years knowledge of the New South Wales and Australian floras has developed enormously. We know a great deal about the distribution and ecology of many species. We are increasingly aware of the need for conservation. While not losing sight of the big picture, much more intensive local study will be required if the diversity of flora observed by Robert Brown is to be retained.

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# A preliminary overview of what is reserved in the Inverell and Yallaroi Shires, North Western Slopes, NSW

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A brief assessment is made of the adequacy of the formal conservation reserve network within the Inverell and Yallaroi Shires, around Inverell and Warialda, northern New South Wales. The current reserve network consists of two National Parks (Kings Plains & Kwiambal) and three Nature Reserves (Arakoola, Planchonella & Severn River), sampling 2% of the area of the two shires. 62% of the known vascular plant taxa (746 native, 144 exotic) have been recorded within the five reserves, including 27 of the 48 taxa listed as rare or threatened within the shires. Of 30 vegetation communities found within the five reserves, only 13 were considered adequate in terms of extent or condition. Of 18 communities found on basalt, limestone or alluvial soils, only 12% of their area was considered to be good quality stands. 26 communities were only represented in one reserve. Nine Endangered Ecological Communities are listed for the two shires, only four of which are within the formal reserves. The capture and status of assemblages and flora within the five reserves in the Inverell and Yallaroi Shires is inadequate and many of the species and communities contained warrant additional conservation within the formal conservation network.

## Introduction

The Inverell and Yallaroi Shires in northern New South Wales cover an area of almost 1.4 million hectares, based on the towns of Inverell and Warialda, north to the Queensland border. The area is part of the New England Tablelands Bioregion in the east, the Nandewar Bioregion in the centre and in the Brigalow Belt South and Darling Riverine Plains Bioregions in the west. The area covers part of the North Western Slopes and North Western Plains Botanical Regions.

Within the Inverell and Yallaroi Shires, there are five formal conservation reserves under the management of the New South Wales National Parks and Wildlife Service, two National Parks — Kings Plains (8519 ha) and Kwiambal (3487 ha), and three Nature Reserves — Arakoola (3189 ha), Planchonella (450 ha) and Severn River (4308 ha) (Figure 1). These reserves incorporate 19 639 ha, approximately 2% of the area of the two shires (though only 716 ha or 0.01% of the Yallaroi Shire). With little exception these reserves are located within the most rugged country with the least agricultural potential.

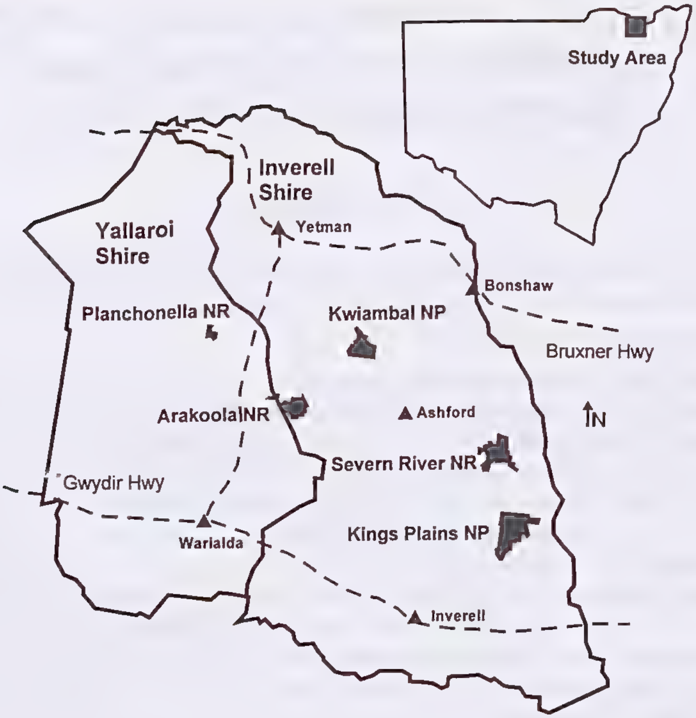

**Fig. 1.** Location of study area showing the Inverell and Yallaroi Shires and the five conservation reserves.

Attempts to assess how representative the capture of communities within a reserve network is usually rely on occurrence, i.e. how many reserves the community has been found within (Specht et al. 1995). Such criteria do not take into account representativeness across the range of the community, or the quality and condition of stands. Just because an assemblage is represented within a reserve is no indication that it is adequate, in terms of extent or condition (viability).

Comprehensive flora and vegetation surveys based on stratified plot sampling, statistical analyses and API mapping have been done for all reserves within the Inverell and Yallaroi Shires, except Planchonella NR, though Planchonella NR has been qualitatively surveyed and does have a flora checklist and mapped vegetation classes. This paper provides a brief summary of the vegetation communities and flora within the reserves and their status, and discusses some of the implications for conservation adequacy within the Inverell and Yallaroi Shires.

## Arakoola Nature Reserve

Arakoola NR (3189 ha) is located 2 km south of Coolatai on the North Western Slopes. The landscape is of low relief but straddles the western fall of the Mastermans Range. Rock types include Late Jurassic Pilliga Sandstone, Tertiary basalts, Tertiary sediments and some Quaternary alluvium.

Formerly part of the freehold properties of Sylvan and Arakoola, land incorporated in Arakoola NR was purchased in 1998 under Natural Heritage Trust Funding and gazetted in 1999. Survey data available includes formal stratified random sampling of the flora (Hunter 2000a) and a number of informal investigations and flora records since the reserve was gazetted and subsequent flora records based on targeted searches for threatened species and general collection.

### Planchonella Nature Reserve

Planchonella NR (450 ha) is located 14 km north west of Coolatai in the Shire of Yallaroi on the North Western Slopes. Freehold land currently used for cropping with some grazing surrounds the reserve. The landscape is of gently undulating low basalt hills, which are often moderately stony.

Planchonella NR, formerly freehold property 'Bim Bimble', was gazetted in 1996 for the high conservation value of the Semi-evergreen Vine Thickets (SEVT), this being considered the largest and most intact remnant of its type on the NSW North Western Slopes. The vegetation and flora has been described by Henderson (1997) and Williams (1994). The reserve was visited by the author and assessed on foot and by aerial photograph interpretation prior to this review.

### Kings Plains National Park

Kings Plains NP (8519 ha) is approximately 50 km north-west of Glen Innes in the Inverell Shire on the North Western Slopes. The Park contains what was formerly Crown Reserve with some newer purchases of private holdings that are yet to be gazetted. The landscape is heavily dissected with numerous steep ridges that fall away to the west but also with some low plateau areas in the north-west of the Park. Rock types within the Park are primarily acid volcanics and include Permian volcanics and Tertiary volcanics with Tertiary and Quaternary weathered products such as laterite.

The Park was gazetted in 1988 for the conservation of woodlands within the North Western Slopes. Roberts (1977) investigated the flora and communities and John Williams (1994) provided a checklist of the flora. Sampling by Nadolny et al. (1998), Gunninah Environmental Consultants (1998) and Hunter (1999) also occurred. Hunter and Clarke (1998) described the vegetation and flora of rock outcrops within the Park. Formal and informal records by other workers have been incorporated within the formal survey and review of the Park (Hunter 2000b). Subsequent additional records have been incorporated into this review.

### Kwiambal National Park

Kwiambal NP (3487 ha, some yet to be gazetted) is approximately 30 km north west of Ashford on the Macintyre River in the Shire of Inverell on the North Western Slopes. The landscape is generally rugged, with low rocky ridges interspersed with areas of deeper soils in gullies or on plateaus. The dominant rock types include metabasalt, limestone, greywacke and granite.

Kwiambal incorporates former freehold land and some Crown Reserves. Part was gazetted in 1998 to conserve some of the largest areas of remnant woodlands on the North Western Slopes. The flora and vegetation of the reserve area has been surveyed by Roberts (1982; 1983), Le Brocque and Benson (1995), Nadolny et al. (1998), Hunter (1998), Hunter and Clarke (1998), Hunter (1999) and Hunter et al. (1999). The reserve has been visited for additional collections by the author several times since these formal reports and subsequent observations have been incorporated into this review.

### Severn River Nature Reserve

Severn River NR (4308 ha) is approximately 60 km north-west of Glen Innes and 4 km upstream from the Pindari Dam wall on the North Western Slopes. The landscape is undulating to hilly with the Severn River forming a major gorge through the Reserve. The rock types contained include Permian and Tertiary Volcanics with a minor intrusion of basalt and some Tertiary and Quaternary weathered products such as laterite.

Severn River NR, incorporating Crown Reserve and recently purchased freehold properties, was gazetted in 1968 with additions in 1998. Surveys of the vegetation and species are given in Department of Water Resources (1991), Bowlay (1992), Le Brocque and Benson (1995), Nadolny et al. (1998), Hunter and Clarke (1998), Hunter (1999). A comprehensive review and survey of the flora and vegetation of Reserve is in Hunter (2000c). Subsequent visits have been made to the reserve since the comprehensive survey and additional records have been incorporated in this review.

## Methods

A checklist of vascular plant flora taxa was generated for the Inverell and Yallaroi Shires based on information from flora surveys conducted within these shires. Primary sources included Department of Water Resources (1990), Harden (1991–1993), Bowlay (1992), Le Brocque and Benson (1995), Henderson (1997), Gunninah Environmental Consultants (1998), and Hunter (1998; 1999; 2000a,b,c). These sources were also used to collate information on taxa and communities found in the five conservation reserves. No comprehensive surveys of the regions outside of the conservation areas within the shires have been finalised at the time of writing this paper. Thus the sources used are likely to be incomplete in terms of the total flora within the two shires, though the majority of species are likely to have been taken into account in this treatment.

Vegetation communities within the five reserves were qualitatively grouped based on the author's field experience. The condition and area covered by each community were summarised from information contained within the reserve reports (Henderson 1997; Hunter 1998; Hunter 2000a,b,c), subsequent visits on foot, and by aerial photograph interpretation of all the reserves. Assessment of condition was based on plot based sampling, traverses through each reserve beyond plot based sampling areas, and aerial photograph interpretation.

The condition of each community was based on a subjective three-point scale. Communities in good condition had little or no visible disturbance and consisted primarily of old growth; those in poor condition were visibly disturbed by factors such as clearing or logging, were substantially of regrowth, or had significant weed invasion. Communities considered in very poor condition were extremely modified and likely to be of a completely derived nature with no natural counterparts; for example had an introduced overstorey or no overstorey where one should have been, or had greater than 50% introduced flora cover. Areas that fell into the very poor condition category included cultivation paddocks. Assessments of condition have been based on overall vegetation quality based on disturbance history even in remote areas and is not biased by accessibility.

The intensity of sampling was considered adequate for these preliminary purposes, as all reserves had been visited on more than one occasion over several years and a total of 311 full floristic 20 × 20 m formal survey plots had been placed within them. Targeted searches for threatened flora were carried out in conjunction with the formal stratified surveys, and on many occasions since. All regions of the reserves have been visited on foot by the author either during formal vegetation surveys (Hunter 2000a,b,c) or since. The algorithm of Incidence-Based Coverage Estimator of species richness was used (ICE) to generate predictive rarefactoin curves (Lee & Chao 1994) that estimate the potential total species richness, this algorithm is contained within EstimateS 5 (Colwell 1999). The predicted total richness based on ICE estimation was compared with the total richness found for each formally surveyed reserve to test adequacy of sampling. During the ICE simulations 200 random samplings were used.

## Results

### Floristics

For the Inverell and Yallaroi Shires 1415 vascular plant taxa were collated from published and unpublished sources — 1152 native (81%), 263 exotic (19%). Of these 890 or 62% were found within the five conservation reserves — 746 native (84%) and 144 (16%) exotic. ICE predicted that Arakoola NR would contain 514 taxa (432 recorded), Kings Plains 467 (439 recorded), Kwiambal 459 (409 recorded) and Severn River 520 (463 recorded).

### Rare or threatened taxa

48 vascular plant species within the two shires are listed on either the NSW *Threatened Species Conservation Act 1995 (TSC Act)* or ROTAP (Briggs & Leigh 1996) (Table 1). Of those on the *TSC Act*, one is listed as Presumed Extinct, 16 as Endangered and 18 as Vulnerable. Under the ROTAP (Briggs & Leigh 1996) criteria four taxa are listed as Endangered, 19 as Vulnerable, 23 as Rare and two as Poorly Known. 27 of these rare or threatened listed flora were recorded within the five conservation reserves, 17 of these in more than one reserve.

**Table 1.** Rare or threatened vascular plant species known from the Inverell and Yallaroi Shires.

| Taxon | TSC Act | ROTAP | Reserve |
|---|---|---|---|
| *Acacia acrionastes* | Endangered | 3RC- | |
| *Acacia atrox* | Endangered | | |
| *Acacia burbidgeae* | | 3RC- | |
| *Acacia granitica* | | 3RC- | |
| *Acacia macnuttiana* | Endangered | 2VCi | |
| *Acacia pubifolia* | Endangered | 2VC- | |
| *Acacia torringtonensis* | | 2RC- | Kings Plains, Severn River |
| *Acacia williamsiana* | | 2RCa | Kings Plains, Kwiambal, Severn River |
| *Allocasuarina brachystachya* | | 2RCa | Kings Plains, Severn River |
| *Astrotricha roddii* | Endangered | 3VCa | Kings Plains, Kwiambal, Severn River |
| *Babingtonia odontocalyx* | | 2VC- | |
| *Boronia granitica* | Endangered | 3VCa | Kings Plains, Severn River |
| *Bothriochloa biloba* | Vulnerable | 3V | Arakoola, Kings Plains |
| *Cadellia pentastylis* | Vulnerable | 3RCa | |
| *Callistemon pungens* | | 3RCa | Kings Plains, Severn River |
| *Cryptandra lanosiflora* | | 3RCa | |
| *Derwentia arenaria* | | 3RCa | Kings Plains |
| *Desmodium campylocaulon* | Endangered | | Arakoola |
| *Dichantheum setosum* | Vulnerable | | Arakoola |
| *Digitaria porrecta* | Vulnerable | | |
| *Discaria pubescens* | | 3RCa | |
| *Dodonaea hirsuta* | | 3RC- | Kings Plains, Severn River |
| *Dodonaea stenophylla* | Extinct | 3V- | |
| *Eucalyptus caleyi* subsp. *ovendenii* | Vulnerable | 2V- | |
| *Eucalyptus rubida* subsp. *barbigerorum* | Vulnerable | | |
| *Eucalyptus malacoxylon* | | 2R- | |
| *Eucalyptus mckieana* | Vulnerable | 2VC- | Kings Plains, Severn River |
| *Eucalyptus nichollii* | Vulnerable | 3V- | |
| *Eucalyptus youmanii* | | 3R- | |
| *Euphorbia sarcostemmoides* | Endangered | 3KCa | Kwiambal |
| *Euphrasia collina* subsp. *muelleri* | Endangered | 2EC- | |
| *Goodenia macbarronii* | Vulnerable | 3VC- | Arakoola, Severn River |
| *Hibbertia kaputarensis* | | 2RC- | |
| *Hibbertia* sp. *B* | | 3RCa | Kings Plains, Severn River |
| *Homopholis belsonii* | | 3R- | |
| *Homoranthus biflorus* | Vulnerable | 2VC- | Kings Plains, Severn River |
| *Homoranthus prolixus* | Vulnerable | 2V- | |
| *Leionema rotundifolia* | | 3RCa | Kings Plains, Severn River |
| *Lepidium hyssopifolium* | Endangered | 3ECi | |
| *Micromyrtus grandis* | Endangered | 2EC | Severn River |
| *Monotaxis macrophylla* | Endangered | | |
| *Olearia gravis* | | 3KCa | Arakoola, Kings Plains, Kwiambal, Severn River |
| *Persoonia terminalis* subsp. *recurva* | | 2RC- | Arakoola, Kings Plains, Severn River |

| **Taxon** | **TSC Act** | **ROTAP** | **Reserve** |
|---|---|---|---|
| *Persoonia terminalis* subsp. *terminalis* | | 2RC- | Arakoola, Severn River |
| *Phebalium glandulosum* subsp. *eglandulosum* | Endangered | 2VCi | |
| *Picris evae* | Vulnerable | 3V | |
| *Platyzoma microphyllum* | Endangered | | |
| *Polygala linariifolia* | Endangered | | Kwiambal |
| *Pomaderris queenslandica* | Endangered | | Arakoola, Severn River |
| *Prostanthera cryptandroides* | Vulnerable | 2RC- | |
| *Pultenaea stuartiana* | Vulnerable | 3VC- | Severn River |
| *Rutidosus heterogama* | Vulnerable | 2VCa | |
| *Swainsona murrayana* | Vulnerable | 3VCi | |
| *Thelionema grande* | | 3RCa | |
| *Thesium australe* | Vulnerable | 3VCi | Arakoola, Kings Plains, Kwiambal |
| *Tylophora linearis* | Vulnerable | 3E | |
| *Zieria odorifera* | | 3RCi | Kings Plains |

**Table 2.** Reservation status and condition of communities within the Inverell and Yallaroi Shires.

| **Assemblage** | **Reserve** | **Condition** | **Area** |
|---|---|---|---|
| **1 Communities associated with wetlands** | **1 Reserve** | | **8 ha** |
| 1 Herbfield/Sedgeland *Rorippa eustylis–Eleocharis plana* | Arakoola | Very poor | 8 ha |
| **2 Communities associated with riparian zones** | **5 Reserves** | **Poor–v. poor** | **975 ha** |
| 2.1 Rough Barked Apple River Flats *Angophora floribunda* | Severn River | Very poor | 147 ha |
| 2.2 Rough Barked Apple – River Oak Open Woodlands *Angophora floribunda – Eucalyptus banksii – Casuarina cunninghamiana* | Kings Plains | Poor | 120 ha |
| 2.3 Rough Barked Apple – Weeping Bottlebrush *Angophora floribunda – Callistemon viminalis* | Arakoola | Poor | 162 ha |
| 2.4 Red Gum – Rough-barked Apple Woodlands *Eucalyptus blakelyi – Angophora floribunda – E. camaldulensis* | Kwiambal | Poor | 523 ha |
| 2.5 River Oak *Casuarina cunninghamiana* | Severn River | Poor | 3 ha |
| 2.6 Wilga – Weeping Myall *Geijera parvifolia – Acacia pendula* | Planchonella | Poor | 20 ha |
| **3 Communities associated with alluvial areas, basalt or limestone soil** | **5 Reserves** | **Usually poor** | **2860 ha** |
| 3.1 Yellow Box – Red Gum – Rough-barked Apple Woodlands *Eucalyptus melliodora – Angophora floribunda – E. blakelyi* | Arakoola<br>Kings Plains<br>Kwiambal<br>Severn River | Poor<br>Good<br>Poor<br>Poor | 24 ha<br>268 ha<br>200 ha<br>21 ha |
| 3.2 Grassy White Box Woodlands *Eucalyptus albens* | Kings Plains | Good | 24 ha |
| 3.3 White Box – Silver-leaved Ironbark Woodlands *Eucalyptus albens – E. melanophloia – E. crebra* | Arakoola | Poor | 1180 ha |
| 3.4 White Cypress Pine – Silver-leaved Ironbark – White Box Woodlands *Callitris glaucophylla – Eucalyptus melanophloia – E. albens* | Kwiambal | Poor | 523 ha |
| 3.5 Silver-leaved Ironbark – Wilga Woodlands *Eucalyptus melanophloia – Geijera parvifolia* | Planchonella | Poor | 50 ha |

| Assemblage | Reserve | Condition | Area |
|---|---|---|---|
| 3.6 Belah – Brigalow Woodlands *Casuarina cristata – Acacia harpophylla* | Planchonella | Poor | 20 ha |
| 3.7 White Cypress Pine – Rough-barked Apple – Kurrajong Woodlands *Callitris glaucophylla – Angophora floribunda – Brachychiton populneus* | Kwiambal | Poor | 200 ha |
| 3.8 White Cypress Pine – Silver-leaved Ironbark Woodlands *Callitris glaucophylla – Eucalyptus melanophloia* | Kwiambal | Good | 340 ha |
| **4 Communities associated with sandstone** | **1 Reserve** | **Good** | **1383 ha** |
| 4.1 Smooth-barked Apple – Long-fruited Bloodwood Woodlands *Angophora leiocarpa – Corymbia dolichocarpa* | Arakoola | Good | 602 ha |
| 4.2 Smooth-barked Apple – Red Stringybark Woodland *Angophora leiocarpa – Eucalyptus macrorhyncha* | Arakoola | Good | 781 ha |
| **5 Communities associated with acid substrates with deep soils** | **3 Reserves** | **Generally good** | **2957 ha** |
| 5.1 White Cypress – Tumbledown Gum Woodlands *Callitris glaucophylla – Eucalyptus dealbata* | Kwiambal | Good | 1744 ha |
| 5.2 Tumbledown Gum – Narrow-leaved Ironbark Woodlands *Eucalyptus dealbata – E. crebra* | Severn River | Good | 432 ha |
| 5.3 Narrow-leaved Ironbark – Orange Gum Shrubby Woodlands *Eucalyptus crebra – E. prava – E. andrewsii* | Severn River | Good | 112 ha |
| 5.4 McKie's Stringybark – Blackbutt Open Forest *Eucalyptus mckieana – E. andrewsii – Callitris endlicheri* | Kings Plains | Poor | 31 ha |
| 5.5 Red Stringybark – Ironbark Woodlands *Eucalyptus macrorhyncha – E. crebra – E. dealbata* | Kings Plains | Good | 638 ha |
| **6 Communities associated with the margins of rock outcrops** | **2 Reserves** | **Good** | **8374 ha** |
| 6.1 Tumbledown Gum – Caley's Ironbark – Orange Gum | Kings Plains | Good | 4970 ha |
| Woodlands *Callitris endlicheri – Eucalyptus dealbata – E. caleyi – E. prava* | Severn River | Good | 2732 ha |
| 6.2 Orange Gum – Ironbark Shrubby Open Woodlands *Eucalyptus prava – E. caleyi – E. macrorhyncha* | Kings Plains | Good | 672 ha |
| **7 Communities associated with rock outcrops** | **3 Reserves** | **Good** | **876 ha** |
| 7.1 Severn Shrublands<br>Eastern: *Calytrix tetragona – Leptospermum novae-angliae – Leucopogon neoanglicus*<br>Western: *Melichrus urceolatus – Leucopogon melaleucoides – Cryptandra amara* | Kings Plains | Good | 250 ha |
| | Severn River | Good | 426 ha |
| 7.2 Cypress Pine – Tumbledown Gum Woodlands *Callitris endlicheri – Callitris glaucophylla – Eucalyptus dealbata* | Kwiambal | Good | 200 ha |
| **8 Dry rainforest influenced** | **2 Reserves** | **Good** | **723 ha** |
| 8.1 Mixed Stands *Alphitona excelsa – Corymbia dolichocarpa* | Kwiambal | Good | 523 ha |
| 8.2 Semi-evergreen Vine Thicket *Ehretia membranifolium – Elaeodendron australe* | Planchonella | Good | 200 ha |
| **9 Other communities mainly of a derived nature** | **3 Reserves** | **Very Poor** | **1466 ha** |
| 9.1 Tea-tree Shrublands and Grasslands *Leptospermum brevipes – L. neo-anglica* | Severn River | Very Poor | 782 ha |
| 9.2 Windmill Grass Grasslands *Chloris truncata – Sporobolus elongatus* | Arakoola | Very Poor | 534 ha |
| | Planchonella | Very Poor | 150 ha |

## Communities

Nine communities have been formally listed as Endangered within the Inverell and Yallaroi Shires. Seven are listed under the NSW *Threatened Species Conservation* Act 1995: Brigalow, *Cadellia pentastylis* (Ooline) community, McKies Stringybark/ Blackbutt Open Forests, the Howell Shrublands, White Box–Yellow Box–Red Gum Woodlands, Carbeen (*Corymbia tessellaris*) Open Forests and Semi-evergreen Vine Thickets. Two are listed on the Federal *Environmental Protection and Biodiversity Act* 2000, Bluegrass (*Dichantheum* spp.) dominant Grasslands and Grassy White Box Woodlands. Four of these, McKies Stringybark/Blackbutt Open-forests, Grassy White Box Woodlands, White Box – Yellow Box – Red Gum Woodlands and Semi-evergreen Vine Thickets have been captured within the five reserves.

30 vegetation communities were found within the five reserves (Table 2). Of these 16 were in poor or very poor condition and accounted for 5517 ha (28%) of the reserved area. 18 communities occurred on basalt, limestone or alluvial soil types, 15 of these accounted for 93% of all communities in poor or very poor condition. Of the 12 communities found on granite or sandstone soils only one was thought to be in poor condition. 26 communities were only captured within one reserve, with four being captured in only two reserves.

## Discussion

Although the five National Parks & Wildlife Service reserves make up only 2% of the land area in the Inverell and Yallaroi Shires, they capture 62% of the total vascular flora, 56% of the listed rare or threatened vascular flora species, and four of the nine listed Endangered Ecological Communities. The 38% of species not captured within the reserve network were from all districts within the two shires but incorporated a larger proportion of species more common in the North Western Plains.

Occurrence however does not equate with adequacy, and many of the 30 communities are not sufficiently sampled or representative. Nine communities each cover an area of 50 ha or less, two of these cover less than 10 ha each and as such are unlikely to be self-sustainable in the long term. In terms of condition, 24% of the reserved land area and 60% (16) of all communities are poor or very poor. Thus, only 13 (43%) communities captured within reserves could be considered adequate in terms of area (more than 50 ha) and condition. In terms of duplication, only four (12%) communities were captured in two different reserves.

The condition of the communities within reservation is heavily biased in favour of assemblages occurring on poor soils such as acid volcanics or granite. Communities on these soil types accounted for 72% (9437 ha) of the reserve area but only 40% or 12 of the communities, with only one in poor condition. This is in contrast to the 18 communities (60%) found on basalt, limestone or alluvial soils which accounted for 5517 ha of the area (28%) of which only 632 ha (12%) was considered to be in good condition. Therefore, although communities on basalt, limestone and alluvial soils are found within the reserve network in the Inverell and Yallaroi Shires, their occurrence is not an indication of adequacy.

As sampling outside conservation reserves in the two shires is currently limited, this compilation could not compare the extent of communities outside the reserves to the extent within. Nor could quantitative comment be made on the number and type of communities that exist outside the reserve network. Thus, this discussion has a number of limitations, particularly in commenting on the comprehensiveness of community representation. It can be inferred, however, that the capture of communities in the current five reserves is inadequate. For example, the Ashford 1: 100 000 Map Sheet incorporates the Severn River NR and part of Kwiambal NP. Here Le Brocque and Benson (1995) describe 13 communities. Of these only seven are potentially synonymous with those listed here. As such, on a map sheet that includes much of the reserve network within the two shires, only about half of communities described have been captured. It is likely that within the Yallaroi Shire, where only 0.01% of the land area is within reserves, a far greater number of communities are not represented. The listing of Endangered Ecological Communities for the study area provides further evidence as only four out nine are within these formal reserves.

## Conclusion

This compilation of information provides a preliminary picture — whether each community type or species is truly adequately represented needs more intensive investigations. However, this type of investigation does provide an insight into the overall formal reservation adequacy of the vegetation communities within the shires and shows the bias and potential inadequacy of current land acquisition. In particular, the information indicates that even if a community type is known to have its distribution within a conservation reserve, it may not be in good condition. The reservation status of assemblages and species within the two shires is likely to be inadequate. Measures are needed not only to provide a comprehensive sampling of assemblages and taxa, but also additional sampling of good quality representatives of many assemblages already represented.

## Acknowledgements

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# Comparative population studies in two *Cissus* species (Vitaceae) across fragmented and undisturbed rainforest habitats

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This preliminary study investigated the interaction between ecological, environmental and genetic factors among two native vines, *Cissus hypoglauca* and *Cissus sterculiifolia* (family Vitaceae). Data from a number of fragmented populations within the Big Scrub and surrounding rainforest areas in northern NSW were used to investigate how closely related vines respond to habitat fragmentation. What has emerged is an account of two species occupying fairly distinct ecological niches, and consequently being differently affected by current environmental disturbances. *Cissus hypoglauca* appears to have greater ecological amplitude, including resilience to drier environmental conditions, while in the long term *Cissus sterculiifolia* is likely to be more extensively affected by rainforest degradation and fragmentation. Genetic analysis suggests that prior to extensive clearing the Big Scrub provided a continuum for gene flow across otherwise fairly disjunct rainforest areas. This pilot study illustrates how simple research can often support the development of long-term conservation and management strategies at the species and plant community level.

## Introduction

Rainforest habitats worldwide are increasingly under pressure from degradation, over-exploitation and clearing. In north-eastern New South Wales, the Big Scrub Lowland Rainforest originally extended from the Richmond River to the Nightcap Range and across to the coastal escarpment. The area included the rich basalt and basalt alluvia denoting ancient volcanic activity in the region (Lott & Duggin 1993). Early vegetation cover occupied an area of more than 75 000 ha and, prior to European settlement, represented the largest continuous expanse of lowland sub-tropical rainforest in Australia (Adam 1992). The Big Scrub is included within a very important biodiversity region extending across the eastern border between NSW and Queensland; over 50 endemic genera are found in this region and more than 200 species are at their most southern or northern limits (Lott & Duggin 1993). Unfortunately, swift environmental degradation through logging and clearing resulted in the demise of most of the original rainforest cover by the early twentieth century (Connelly & Specht 1988). Today, less than 600 ha (approximately 0.7%) of the Big Scrub remain, arguably elevating it to the ranks of one the most endangered rainforest communities in the world. What is left is fragmented into around 40 isolated remnants, many under 10 ha in size but still containing remarkable species diversity (Lott & Duggin 1993). These rainforest fragments are small, under pressure from numerous external factors and unlikely to be evolutionary viable in the long term unless appropriate conservation and management actions are undertaken.

Lianas (or woody vines) play an important role in rainforest regeneration, maintenance of biodiversity and ecosystem processes. They are a polyphyletic group sharing a common strategy based on using the architecture of other plants to ascend the canopy (Schnitzer & Bongers 2002). The Vitaceae family is an important world-wide group of woody climbers with five genera and 30 species represented in Australia. Recent molecular studies have shown that *Cissus* (the largest genus with 14 Australian species, Jackes 1988) is not monophyletic, with five species being segregated from it (Rossetto et al. 2001, Rossetto et al. 2002). Two of these species, *Cissus hypoglauca* A. Gray and *Cissus sterculiifolia* Planch., are reasonably common in NSW and are the focus of this study. *Cissus hypoglauca* (Giant Water Vine) is a vigorous evergreen vine with thick stems, rusty-pubescent young shoot and tendrils, and five-foliate, palmately-compound leaves. Inflorescences are paniculate with terminal umbels and berries are purplish-black and globular. It occurs from southern New Guinea to Victoria in southern Australia, and is associated with rainforests, vine forests and occasionally eucalypt forest margins (Jackes 1988). *Cissus sterculiifolia* is also an evergreen, vigorous vine with palmately-compound leaves and a prominent yellowish-green midrib. Inflorescences are umbellate and the ovoid to elongate-falcate berries are purplish-black. This species occurs in rainforests from southern New Guinea to northern NSW (Australia) with occasional records as far south as Sydney (Jackes 1988).

The importance of vines in the dynamics of forest community has been rarely investigated (Arnold 1999, Schnitzer & Carson 2001). As a result, the understanding of their role in forest dynamics has lagged behind that of other plant groups (Schnitzer & Bongers 2002). Within an undisturbed and well-structured forest edge or a mid-sized gap vines can produce a dense foliage cover, which protects the forest from damaging external factors such as wind, light, weeds and disease (Wiens et al. 1985). Forest disturbance, or 'edge effect', can be detected up to 500 m within the margin of a forest, with the first 200 m being the most affected (Sizer & Tanner 1999, Mesquita et al. 1999). Where large openings or significant edge disturbance occur, drying winds and sunlight penetration can have irreversible effects on shade and humidity-loving species (Winter et al. 1984). Furthermore, weed species are usually more competitive in disturbed habitat (Bungard et al. 1998) potentially increasing the loss of native species diversity (Connelly & Specht 1988). The rapid growth rates and spread of native vines make them efficient competitors as they rapidly close gaps. However they are sometimes considered as having a negative impact on tree regrowth, especially within smaller remnants and, as a consequence, are deliberately restrained.

Vines also play an important role in organic matter cycles and soil stabilisation. This is because lianas, unlike most trees, allocate greater biomass to photosynthetic tissues than to supporting structures (Roldan & Varela 1999). However, vines are different from other structural parasites in that they remain rooted to the ground (Schnitzer & Bongers 2002). As a result, their contribution to the leaf litter reaches up to 24 % in subtropical rainforests in North Eastern NSW (Hegarty 1988). Overall, vines have an important role in the regeneration and conservation of rainforests, particularly within disturbed habitats.

The aim of this study was a preliminary investigation of the ecological, genetic and environmental factors affecting distribution and persistence of *Cissus hypoglauca* and *C. sterculiifolia*. The data obtained from a mixture of fragmented sites from the Big Scrub and undisturbed sites from surrounding rainforest areas will represent a new insight into the effects of rainforest clearing on native vine species.

## Materials and Methods

### Sites description

Our study compared some of the biggest remaining Big Scrub fragments to undisturbed areas within northern and southern regions of north-eastern NSW. In data analysis, belonging to a rainforest area was measured as a binomial value. For each individual sampled for genetic analysis relevant ecological data was also recorded. The ecological descriptors were selected according to a previous study on vines in Europe (Arnold 1999). However, not all the populations considered in the genetic study could be used in the ecological investigation (Table 1). The Broken Head and Evans Head populations had had their structure significantly changed by fire, while the Nimbin, Lumley Park and Tuckombil populations were too small to be considered within the ecological analysis.

**Table 1.** Sites sampled for ecological and DNA analysis showing altitude and population size for *Cissus hypoglauca* and *Cissus sterculiifolia* (the shaded populations were removed from the ecological analysis — see text for explanation).

| **Population** | **Sites** | **Altitude** | **Estimated population size for:** | |
|---|---|---|---|---|
| **groups/regions** | **range (m)** | | ***C. hypoglauca*** | ***C. sterculiifolia*** |
| Big Scrub | Broken Head | 5–50 | > 20 | 10–20 |
| | Duck Creek | 51 | > 20 | 0 |
| | Davis Scrub | 170 | 0 | 10–20 |
| | Lumley Park | 120 | 3 | 1 |
| | Victoria Park | 150 | 2 | 10–20 |
| | Uralba | 135 | > 20 | 0 |
| | Tuckombil | 100 | 2 | 0 |
| Southern Coast | Evans Head | 4 | > 20 | 0 |
| | Iluka | 5 | > 20 | > 20 |
| Northern Ranges | Nimbin | 230 | 2 | 0 |
| | Terania Creek | 100–190 | > 20 | 10–20 |
| | Whian Whian | 200–400 | > 20 | > 20 |

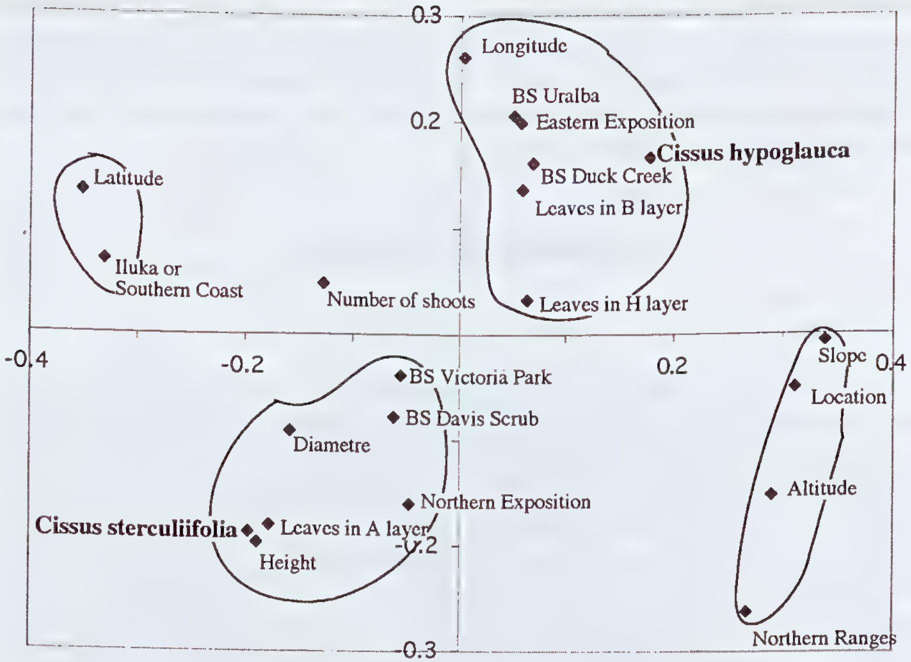

**Fig. 1.** Projection of the 21 descriptors on the first two axes of the correspondence analysis (CA). BS denotes sites within the Big Scrub area.

## Environmental descriptors

Latitude and longitude were determined using a GPS (Garmin type) or estimated on a 1: 25 000 map when tree coverage was too dense for efficient satellite reception (degrees were converted into decimal numbers). Altitude was measured using an altimeter of the type Thommen Classique 6000 and confirmed on the same maps. Slope was described as a semi-quantitative descriptor varying from 0 for a flat landscape to 2 for a slope of more than 30 degrees. Exposure was measured with a compass and divided into two quantitative components: Expo N and Expo E. These values correspond to the sine and cosine of the angle read on the compass and deferred on a circle of radius 1 (East (1; 0), North (0; 1), West (-1; 0) and South (0; -1)).

A semi-quantitative descriptor ('Disturbance' on Figure 1) varying from 0 to 6 was used to describe the condition of the forest edge. The following values were used: 0 = inside the rainforest; 1 = in a gap; 2 = non-cultivated edge opening; 3 = edge close to a plantation or an open agricultural area; 4 = edge bound by a pathway; 5 = edge bound by an unsealed road; 6 =edge bound by a sealed road.

## Structural descriptors

The circumference of vine trunks was measured as close to the ground as possible (breast height was not always suitable as vines often grew along the ground). If many shoots were present, the largest in circumference was measured. The precision of this measurement was rounded to 0.5 cm (quantitative variable). Number of shoots was scored as a semi-quantitative variable: 1 = 1 to 5 shoots; 2 = 5 to 10 shoots; 3 = 10 to

20 shoots; 4 = over 20 shoots. Height (quantitative variable) was estimated when possible but for individuals of more than ten metres measures were generally obtained using an eclimetre as the top of the vines was masked by tree foliage. The abundance of *Cissus* foliage in each of the three vegetation layer (H layer = herbaceous <1m; B layer = bush 1 m to 6 m; A layer = tree > 6 m) was noted as a semi-quantitative variable coded from 0 (absent) to 3 (very abundant).

Population size of *C. sterculiifolia* and *C. hypoglauca* within each site was described as a semi-quantitative value varying from 0 to 5: 1 = 1 individual; 2 = 2 to 5 individuals; 3 = 6 to 10 individuals; 4 = 11 to 20; 5 = over 20 individuals.

### Analysis of ecological data

In order to compare the interactions between descriptors, populations and species multivariate analysis was performed. The square matrix used for the analysis consisted of 106 individuals and 21 descriptors. The ecological data were standardised using Progiciel R4.0 developed by Philippe Casgrain and Pierre Legendre at Montréal University (Legendre & Legendre 1998). A correspondence analysis (CA) was performed on standardised data using Canoco (Ter Braak 1991). This analysis was completed by further multivariate analyses using Progiciel R 4.0. An euclidian distance matrix was used for the two Mantel tests. For all these, 999 permutations were performed and a Bonferroni correction was made on the multiple-tests bootstrap.

### Genetic analysis

Microsatellites, or simple sequence repeats (SSRs), are often used as the genetic marker of choice for population studies. Abundant and uniform distribution throughout the genome, codominant inheritance, simple screening requirements and reproducibility make SSRs particularly attractive to a multitude of applications. Initially described as species-specific, an increasing number of studies are showing that SSRs can be efficiently transferred across related taxa (Rossetto et al. 2000, Scott et al. 2000, Arnold et al. 2002). In fact, close to 80 % transfer success can be expected within genera and around 35 % within families (Rossetto 2001). A recent study by Arnold et al. (2002) showed that a number of SSRs characterised for *Vitis vinifera* could be successfully transfer across *C. hypoglauca* and *C. sterculiifolia* and produce meaningful population data. Four of these loci were used to assess genetic diversity across the selected populations of the two vine species (Table 2).

**Table 2.** Name, repeat type, optimal annealing temperature and numbers of alleles for each vine species for the four SSR loci. Two loci were used for *Cissus hypoglauca* (scu15vv and vmc8D11) and three for *Cissus sterculiifolia* (scu06vv, scu08vv and scu15vv). Not analysed loci are indicated as na.

| **Locus** | **Repeat type** | **Annealing temperature** | **Number of alleles for** *C. hypoglauca* | *C. sterculiifolia* |
|---|---|---|---|---|
| scu06vv | AT | 50°C | na | 8 |
| scu08vv | GGT | 58°C | na | 5 |
| scu15vv | GAA | 54°C | 11 | 6 |
| vmc8D11 | GA | 61°C | 9 | na |

When possible, leaf material from fully-grown vines, was sampled from a number populations representing three distinct geographic groups: Big Scrub, Northern Ranges and Southern Coast (Table 1). Total DNA was extracted using a CTAB method previously described by Rossetto et al. (2001). PCR amplifications were performed in 25 $\mu$l reaction volumes containing 10 $\mu$mol/L Tris-HCl, 50 $\mu$mol/L KCl, 2.5 $\mu$mol/L $MgCl_2$, 0.5 unit Taq polymerase (Roche), 0.2 $\mu$mol/L of each dNTP, 5 $\mu$mol/L of each forward and reverse primer, 25 ng of template DNA plus DNA-free water to make up the total volume. PCRs were run under the following conditions: an initial denaturation step of 94°C for 4 min., followed by 30 steps of 94°C for 30 sec, 48°C–61°C (depending on the primer used — see Table 2) for 30 sec, 72°C for 30 sec, with a final extension step at 72°C for 7 min.

PCR products were initially run on a 2% agarose gel and visualised using ethidium bromide in order to verify amplification success. If amplification was successful, the PCR products were run on a laser-scanning polyacrylamide gel system, the Gel-Scan 2000 (Corbett Research) and visualised with ethidium bromide in order to assess the size range. Samples were run on an 18 cm long, 0.1 mm thick 6% polyacrylamide non-denaturing gel at 1200 V. Descriptive population statistics for the two study species were obtained using GDA 1.1 (Lewis & Zaykin 2002).

## Results and disussion

### Ecological data

The first three axes of the correspondance analysis (CA) performed on a square matrix composed of 106 individuals and 21 descriptors, explain 53.1% of the total variance (25.9% for axis 1; 15.8 % for axis 2; 11.4 % for axis 3). Figure 1 represents the projection of these 21 descriptors on the first two axes of the CA. Along the first axis a notable gradient of altitude and slope can be observed, while the second axis appears to be more influenced by structural descriptors. This preliminary ecological study shows differences in the ecology and performance of these two species.

If the relationships among structural descriptors are considered independently of the presence or abundance of both *Cissus* species, a correlation between diameter, plant height and the leaf abundance in the tree layer can be observed. This correlation is confirmed by a Mantel test (p=0.001) between the diameter matrix and a matrix grouping the other two descriptors. Vines usually reach the highest canopies after long persistent growth tracking that of the supporting species. If only a low quantity of light reaches the base of a tendril climber, the production of exploring shoots or ramets close to the base would result in a loss of energy. As a result, within such conditions vines attempt to put most of their growth efforts into maintaining their position within the canopy and in colonising more than one tree within the tree layer where light supply is higher (Putz & Mooney 1991). In order to counterpart the hydraulic constraints, the vine needs to develop an increasingly thicker stem resulting in the positive correlation between height, leaf production in the tree layer and diameter. On the other hand if a large quantity of light reaches the base of a tendril climber, the production of exploring shoots does not represent a loss of energy.

In such circumstances, lateral expansion of the vine will lead to a greater production of leaves in the herbaceous and bush layer. A Mantel test performed between a matrix containing the number of shoots and a matrix representing the abundance of leaves in the bush and herbaceous layer, confirmed the existence of a positive correlation between these values (p=0.004). These results suggest the presence of a correlation between leaf number across the various layers, shoots size and shoot number. A greater number of leaves in the tree layer corresponds to greater height and larger stem size. A greater number of leaves in the bush and/or herbaceous layers corresponds to a greater number of shoot.

Figure 1 clearly segregates between the abundance of *Cissus hypoglauca* and *C. sterculiifolia* as they occupy opposed positions on the graph. This segregation is independent of altitude, latitude and shoot number but is likely to be accentuated by the uneven abundance of these two species within the Big Scrub remnants. Uralba and Duck Creek contain only *C. hypoglauca*, while Victoria Park and Davis Scrub have greater numbers of *C. sterculiifolia*. This study shows a link between *C. sterculiifolia*, northern exposure of the slope and higher abundance of leaves in the tree layer (Fig. 1). *C. sterculiifolia* vines were mostly found inside rainforests and on flat areas (or areas with a weak slope). Conversely, *C. hypoglauca* was more abundant along the coast as indicated in Figure 1 by the link to longitude. *C. hypoglauca* produced most of its leaves in the herbaceous and bush layers indicating that it was mainly found on forest edges (Fig. 1).

In contrast to the Big Scrub sites, the sites within the Northern Ranges and Southern Coast regions were bigger and contained both species. These two regions are diametrically opposed (Fig. 1) as Northern Ranges sites are at high altitude while Southern Coast sites are at sea level. The Iluka site is within littoral rainforest with trees kept relatively small as a consequence of the ocean winds blowing over the sand dunes (Specht & Specht 1999). Within this rainforest type both *Cissus* species have a tendency for greater vegetative dynamic as suggested by an increased number of shoots.

In the Northern Ranges, *Cissus sterculiifolia* was mainly found within tall rainforests, while *C. hypoglauca* was mainly found at rainforests edges or in wet sclerophyll forests. Thus this preliminary ecological study suggests that *C. hypoglauca* can occupy drier environmental conditions than *C. sterculiifolia*, which is more closely dependent on humid rainforest habitats.

Non-disturbed edges or tree-fall gaps usually offer vertical structure for all sorts of climbers with a higher density of trees of different height and diameters (Putz & Chai 1987). If the supply of light, temperature and humidity is sufficient, there is no need for vines to invest in vertical growth. As a result, they can concentrate leaf production within the herbaceous and bush layer as observed in the present study and corroborated by other studies (Arnold 1999, Avalos & Mulkey 1999). Furthermore, the ability to form secondary rooting points allows vines to increase leaf area without necessitating excessive stem thickening. This strategy reduces mortality risks, as each stem has the potential to independently continue lateral and vertical exploration.

However, extreme environmental disturbances such as edge effect can lead to excessive moisture losses. Within these drier conditions *C. hypoglauca* seems to be able to adapt better than *C. sterculiifolia* which appears to be more vulnerable to such changes. This lower ability to adapt to changed environmental conditions could explain why *C. sterculiifolia* plants appears to be consistently larger in size (possibly suggesting greater age) and show limited signs of active vegetative reproduction.

## Genetic data

As vine populations within the Big Scrub remnants are small, highly significant data on current population dynamics can be difficult to obtain. Yet despite the limitations imposed by sampling size, some very interesting trends were observed. Of particular interest is the comparative data on population genetics obtained from the Big Scrub, Northern Ranges and Southern Coast.

**Table 3:** SSR data for the *Cissus hypoglauca* populations analysed (using two loci, scu15vv and vmc8D11). For each group, the number of sites investigated (Sites), overall number of individuals (N), overall number of alleles ($A_T$), mean number of alleles per locus (A), expected ($H_E$) and observed ($H_O$) heterozygosity, inbreeding coefficient ($F_{is}$) and fixation index ($F_{st}$) are shown.

| Group | Sites | N | $A_T$ | A | $H_E$ | $H_O$ | $F_{is}$ | $F_{st}$ |
|---|---|---|---|---|---|---|---|---|
| Big Scrub | 6 | 34 | 17 | 2.79 | 0.63 | 0.61 | 0.10 | 0.29 |
| Northern Ranges | 3 | 35 | 12 | 3.00 | 0.53 | 0.62 | -0.01 | 0.25 |
| Southern Coast | 2 | 24 | 13 | 4.75 | 0.76 | 0.59 | 0.22 | 0.12 |
| Overall | 13 | 93 | 20 | 3.15 | 0.62 | 0.61 | 0.09 | 0.25 |

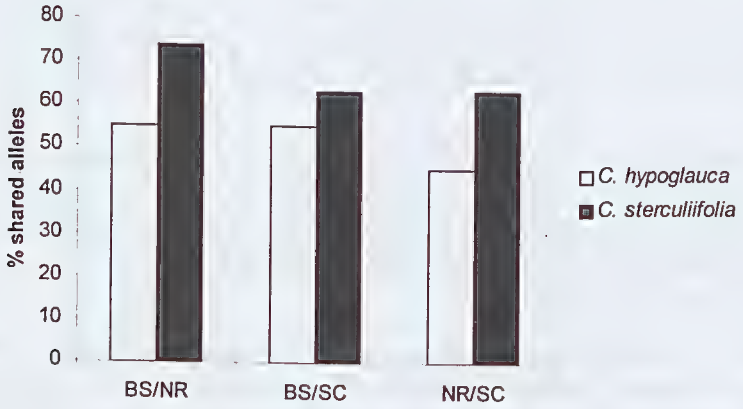

**Fig. 2.** Shared alleles between the Big Scrub (BS), Northern Ranges (NR) and Southern Coast (SC) population groups for *Cissus hypoglauca* and *Cissus sterculiifolia*.

Single *C. hypoglauca* populations had the lowest levels of diversity, as measured by the mean number of alleles per locus, within the Big Scrub (Table 3). This is not surprising, as most of these populations are extremely small and disjunct. As well as low within-population diversity, high fixation index in the Big Scrub (0.29 $F_{st}$, considered as very high by Hartl & Clark 1997) emphasised the structuring caused by population disjunction and habitat fragmentation. However, when grouping single populations within their respective regions, the overall number of alleles was higher in the Big Scrub than in the other two comparative regions (Table 3). Possible explanations for this result are the incomplete sampling of undisturbed populations within the Northern Ranges and Southern Coast, and the presence of residual rare alleles within the small Big Scrub populations. Similar sampling sizes for the Big Scrub and the Northern Ranges produced similar A and $F_{st}$ as well as corresponding levels of heterozygosity (Table 3). Interestingly, more alleles are shared between the Big Scrub populations of *C. hypoglauca* and each of the two other regions, than between the Northern Ranges and Southern Coast (Figure 2). As the Big Scrub is geographically intermediate between these two otherwise distinct areas such allele-sharing patterns suggest that the Big Scrub provided an important corridor for gene flow among geographically disjunct rainforests in northern NSW.

The smaller number of samples available for the genetic investigation on *Cissus sterculiifolia* make population studies even more arduous. Sampling was not an under-representation of the true distribution of *C. sterculiifolia* but reflected a genuine scarcity of this vine at the study sites. Genetic data were more homogeneous than for *C. hypoglauca*, with moderate $F_{st}$ values indicating lower inter-population distinction (Table 4). Overall genetic diversity measured as the total number of alleles was also lower in *C. sterculiifolia* (19 alleles across three loci — Table 4) than in *C. hypoglauca* (21 alleles across two loci — Table 3) with lower heterozygosity levels being also recorded (Table 4). Lower diversity and lesser population structure could be attributed to the fact that *C. sterculiifolia* is more restricted in habitat preferences (as previously suggested by Jackes 1988 and Benson & McDougall 2001). It is possible that this vine has undergone more extreme bottlenecks during recent glaciation events and/or has recently colonised northern NSW from rainforest refugia outside this area.

**Table 4.** SSR data for the *Cissus sterculiifolia* populations analysed (using three loci, scu15vv, scu08vv and scu06vv). For each group, the number of sites investigated (Sites), overall number of individuals (N), overall number of alleles ($A_T$), mean number of alleles per locus (A), expected ($H_E$) and observed ($H_O$) heterozygosity, inbreeding coefficient ($F_{is}$) and fixation index ($F_{st}$) are shown.

| Group | Sites | N | $A_T$ | A | $H_E$ | $H_O$ | $F_{is}$ | $F_{st}$ |
|---|---|---|---|---|---|---|---|---|
| Big Scrub | 4 | 17 | 16 | 3.25 | 0.58 | 0.52 | 0.10 | 0.13 |
| Northern Ranges | 2 | 16 | 17 | 3.00 | 0.48 | 0.29 | 0.53 | 0.05 |
| Southern Coast | 1 | 15 | 14 | 4.67 | 0.75 | 0.44 | 0.42 | na |
| Overall | 8 | 48 | 19 | 3.67 | 0.63 | 0.52 | 0.27 | 0.13 |

This preliminary genetic investigation in the population dynamics of these two native vine species produced some interesting trends — differences in overall species diversity, and the role of the Big Scrub in providing a continuum between southern and northern rainforest populations. Future research should involve more extensive study areas, larger populations, direct measures of gene flow and a greater number of SSR loci. Such an approach would provide more suitable information about the consequences of rainforest fragmentation on the gene flow of two vines that rely on similar dispersal mechanisms but occupy slightly different ecological niches.

## Conclusion

Ecological and vegetation dynamic studies on two *Cissus* species uncovered differences across the Big Scrub remnants. What essentially unites these sites is that they share similar altitude, which is midway between that of the Northern Ranges and the Southern Coast. Genetic analysis confirmed an intermediary role for the Big Scrub, as it appears to have provided a continuum for gene flow across these otherwise disjunct rainforest areas. However, despite the similarity in fruit dispersal mechanisms, there is no clear indication that consistent levels of gene flow are persisting in the currently fragmented habitat.

Some tangible distinctions were detected between the two vines. *Cissus hypoglauca* appears to have the greatest ecological amplitude, including resilience to disturbance and somewhat drier environmental conditions. Land clearing is likely to have reduced overall genetic variability within Big Scrub populations of this species, yet it still exhibits a marginally broader genetic spectrum than *C. sterculiifolia*. Wide range of habitat preference, efficacious vegetative growth, efficient predisposition for dispersal and a broader genetic spectrum make *C. hypoglauca* less susceptible to the detrimental effects of rainforest fragmentation.

*Cissus sterculiifolia* is restricted to more humid rainforest habitats. In northern NSW, and in particular within the Big Scrub area, undisturbed rainforest is increasingly uncommon. Since edge effect decreases humidity, fragmentation is having a greater effect on the long-term survival of this species than for *C. hypoglauca*. Rarity and a narrow genetic spectrum in *C. sterculiifolia* suggest the possible occurrence of past bottlenecks throughout northern NSW. As most of the remaining *C. sterculiifolia* individuals appear to be large and old, it is possible that in most areas they embody senescent populations or relics of a better past. Because of its specific ecological requirements, this species is more likely to disappear in the current fragmented and extensively disturbed conditions.

This preliminary study was not intended to develop a full understanding of population ecology and genetics of these two vine species. Rather it was intended to provide new insights on how two closely related vine species respond to rainforest fragmentation. What has emerged is an account of two species occupying fairly distinct ecological niches, and consequently being differently affected by current environmental disturbances. In the long term, *C. sterculiifolia* is likely to be more extensively affected by rainforest degradation and fragmentation.

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# Ecology of Sydney plant species

## Part 9 Monocotyledon families Agavaceae to Juncaginaceae

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*Benson, Doug and McDougall, Lyn (National Herbarium of New South Wales, Royal Botanic Gardens and Domain Trust, Sydney, Australia 2000) 2002. Email: doug.benson@rbgsyd.nsw.gov.au) 2002. Ecology of Sydney plant species: Part 9 Monocotyledon families Agavaceae to Juncaginaceae.* Cunninghamia *7(4) 695–930.* Ecological data in tabular form are provided on 361 plant species of the families Agavaceae to Juncaginaceae, 260 native and 101 exotics, occurring in the Sydney region, defined by the Central Coast and Central Tablelands botanical subdivisions of New South Wales (approximately bounded by Lake Macquarie, Orange, Crookwell and Nowra). Relevant Local Government Areas are Auburn, Ashfield, Bankstown, Bathurst, Baulkham Hills, Blacktown, Blayney, Blue Mountains, Botany, Burwood, Cabonne, Camden, Campbelltown, Canterbury, Cessnock, Concord, Crookwell, Drummoyne, Evans, Fairfield, Greater Lithgow, Gosford, Hawkesbury, Holroyd, Hornsby, Hunters Hill, Hurstville, Kiama, Kogarah, Ku-Ring-Gai, Lake Macquarie, Lane Cove, Leichhardt, Liverpool, Manly, Marrickville, Mosman, Mulwaree, North Sydney, Oberon, Orange, Parramatta, Penrith, Pittwater, Randwick, Rockdale, Ryde, Rylstone, Shellharbour, Shoalhaven, Singleton, South Sydney, Strathfield, Sutherland, Sydney City, Warringah, Waverley, Willoughby, Wingecarribee, Wollondilly, Wollongong, Woollahra and Wyong. The study area falls within the Sydney Basin IBRA Bioregion.

Families are: Agavaceae, Alismataceae, Alliaceae, Alstroemeriaceae, Amarylidaceae, Anthericaceae, Aponogetonaceae, Araceae, Arecaceae, Asparagaceae, Asphodelaceae, Asteliaceae, Blandfordiaceae, Burmanniaceae, Cannaceae, Centrolepidaceae, Colchicaceae, Commelinaceae, Cyperaceae, Dioscoreaceae, Doryanthaceae, Eriocaulaceae, Flagellariaceae, Haemodoraceae, Hyacinthaceae, Hydrocharitaceae, Hypoxidaceae, Iridaceae, Juncaceae, Juncaginaceae.

Data are derived from herbarium collections, literature and field observations. It is hoped that the many, often alarming gaps in the information available will stimulate much-needed research into the ecology of more of the species. Information is provided so far as available to us for each plant species in the following categories:

**Life History:** Growth form, vegetative spread, longevity, primary juvenile period (time from germination to fruiting), reproduction, flowering and fruiting times, fruit/seed type, dispersal, establishment and growth, fire response, interaction with other organisms.

**Distribution:** Status/origin (native/naturalised), botanical subregions, distribution in Sydney area, selected locations.

**Habitat:** Habitat, altitude, annual rainfall, typical local abundance, vegetation, substrate, exposure.

**Conservation:** Conservation status.

## Introduction

The *Ecology of Sydney plant species* aims to provide ecological information on native and naturalised Sydney plants. Particular emphasis has been given to data that are relevant for ecologists and natural area managers, for people involved in bush regeneration, land rehabilitation and landscape design, for researchers in many fields and for a wide range of people who are interested in bushland and native plants. Species-specific information is also relevant to environmental impact assessment and to studies involving changes in drainage, water movement, wind exposure, nutrient conditions and fire regimes on plant species and plant communities. Information included covers growth form, flowering and fruiting times, longevity and maturation periods, pollination and seed dispersal data, distribution, habitat and plant community, as well as responses to fire and disturbance where available and is complementary to the descriptive texts in taxonomic handbooks such as the *Flora of New South Wales* (Harden 1990–93).

Part 9 of the *Ecology of Sydney plant species* covers the Monocotyledon families alphabetically from Agavaceae to Juncaginaceae. Part 10, Monoctyledon families Lemnaceae to Zosteraceae 2003, Part 11, Monocotyledon family Poaceae 2004.

## Methods

Part 9 follows the format used in Parts 1–8 (Benson & McDougall 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001). The Sydney region is defined as the Central Coast and Central Tablelands botanical subdivisions (i.e. approximately bounded by Lake Macquarie, Orange, Crookwell and Nowra) (Fig. 1). This is the area broadly covered by *Flora of the Sydney Region* (Carolin & Tindale 1993), with the exception that the Hunter Valley is not included here since it lies within the North Coast and Central Western Slopes subdivisions. Relevant Local Government Areas are Auburn, Ashfield, Bankstown, Bathurst, Baulkham Hills, Blacktown, Blayney, Blue Mountains, Botany, Burwood, Cabonne, Camden, Campbelltown, Canterbury, Cessnock, Concord, Crookwell, Drummoyne, Evans, Fairfield, Greater Lithgow, Gosford, Hawkesbury, Holroyd, Hornsby, Hunters Hill, Hurstville, Kiama, Kogarah, Ku-ring-gai, Lake Macquarie, Lane Cove, Leichhardt, Liverpool, Manly, Marrickville, Mosman, Mulwaree, North Sydney, Oberon, Orange, Parramatta, Penrith, Pittwater, Randwick, Rockdale, Ryde, Rylstone, Shellharbour, Shoalhaven, Singleton, South Sydney, Strathfield, Sutherland, Sydney City, Warringah, Waverley, Willoughby, Wingecarribee, Wollondilly, Wollongong, Woollahra and Wyong. The study area falls within the Sydney Basin IBRA bioregion (Interim Biogeographic Regionalisation for Australia).

The Sydney region, as defined here, includes approximately 3500 plant species, both native and naturalised. To deal effectively with this number, the work has been divided into parts each of approximately 350 species based on plant families beginning with ferns, Cycads and Gymnosperms, and then Dicotyledon and Monocotyledon families. Within these groups, families, genera and species are arranged alphabetically:

Part 1: Ferns, Fern allies, Cycads and Conifers, Dicotyledon families Acanthaceae to Asclepiadaceae (*Cunninghamia* 3(2) 1993)

Part 2: Dicotyledon families Asteraceae to Buddlejaceae (*Cunninghamia* 3(4) 1994)

Part 3: Cabombaceae to Eupomatiaceae (*Cunninghamia* 4(2) 1995)

Part 4: Fabaceae (*Cunninghamia* 4(4) 1996)

Part 5: Flacourtiaceae to Myrsinaceae (*Cunninghamia* 5(2) 1997)

Part 6: Myrtaceae (*Cunninghamia* 5(4) 1998)

Part 7a: Nyctaginaceae to Primulaceae (*Cunninghamia* 6(2) 1999)

Part 7b: Proteaceae to Rubiaceae (*Cunninghamia* 6(4) 2000)

Part 8: Rutaceae to Zygophyllaceae (*Cunninghamia* 7(2) 2001)

**Part 9: Monocot families Agavaceae to Juncaginaceae (Cunninghamia 7(4) 2002)**

Part 10: Monocotyledon families Lemnaceae to Zosteraceae

Part 11: Monocotyledon family Poaceae

For each species (and generally for subspecies) a data sheet is prepared incorporating life history, distribution and habitat data from specimens in the National Herbarium of New South Wales; this information is entered in a database together with data from literature sources both published and unpublished. References have been cited where appropriate but for unreferenced data responsibility has been assumed by the authors. A provisional compilation sheet with the available information is then prepared and distributed to interested persons for comments and additions/alterations. This compilation is then published in parts in the summer issue of *Cunninghamia,* with the subsequent long-term aim of producing a book at the completion of the eleven parts. This will allow the incorporation of new and additional material.

Part 10, Monocotyledon families Lemnaceae to Zosteraceae, is planned for publication in 2003, and any information that readers would like included should be sent to the authors by 30 June 2003.

Ecological review papers may be appropriate for families in future issues, particularly the major families e.g. Poaceae, Orchidaceae, but papers would also be welcomed for smaller families. Authors interested in contributing such papers should contact the Scientific Editor.

## Information categories

For each species or subspecies, information is presented under headings relating to different life-history aspects, each with further subdivisions. Emphasis has been given to understanding the species in its wild habitat. For this reason data on cultivation and artificial propagation, available in horticultural books, are generally not included. Likewise information on weed control is not given. Generally, the categories are broadly interpreted and since the project aims to stimulate further investigation, we welcome the addition of extra data on any other aspects of the plant's ecology.

A 'comments' section has been deliberately avoided — for all information retrieval purposes, all ecological material should be attributable to some life history aspect of the plant or its habitat although even with our broad categories there have been problems with 'Vegetation' and 'Substrate' sections for specialised lifeforms such as mistletoes. The main purpose of this information is to give a picture of the ecology of particular species as is currently known. It is not primarily for comparative purposes although it can be used in this way. One of our original aims was to demonstrate that closely related species may have different ecologies and that to generalise within genera for example rather than look at a particular species is an over simplification. We have also included reference to individualistic information resulting from specific research that will not necessarily be available for all species.

Similarly where we have observations on the effects of factors such as drought on particular species we have included these, though we have not included a category for 'drought' because of difficulties in definition. One of our aims is to be open-ended, to point out that there are many gaps in the ecological knowledge and to indicate areas and species where future work may be particularly useful.

## Botanical nomenclature

**Family/Genus/Species**: Names currently recognised at the National Herbarium of NSW and mostly as used in *Flora of New South Wales* and Plantnet:
http://plantnet.rbgsyd.nsw.gov.au/

**Common name**: Names used in *Flora of New South Wales.*

## Life history

**Growth form**: Brief description.

Source: *Flora of New South Wales.*

**Vegetative spread**: Indication of whether localised expansion or spread is possible from an individual by rhizome, stolon, rootsucker etc. Important in determining ability of species to colonise immediate local area. Does not include vegetative distance-dispersal which is included under 'Dispersal, establishment & growth' (diaspore).

Source: Flora descriptions, Herbarium specimens, field observations.

**Longevity**: Average potential life-span under natural conditions — range in years where possible, indefinite, where death is not a result of inherent growth e.g. continued rhizomatous growth. Longevity may be shorter in cultivation. There are very few references in the literature to the longevity of species or records of individual plants, particularly of the longer-lived species, yet this is an important factor in assessing importance of recruitment and changes in plant communities.

Most of the estimates given are based on the authors' judgement, based on the shape, size and growth rates of individuals, and the authors' experience in the field over 25 years, together with any historical data available. The figures given are conservative and represent minimal average ages. The authors would not be surprised if much greater ages are achieved in many cases.

Source: literature, authors' assessment from field observations.

**Primary juvenile period**: time taken from germination to produce first fruits or spores. Gill (1975) uses the term for the period from germination to flowering but the period to fruit maturity is more significant ecologically. Secondary juvenile period is time taken for an individual to recover to produce fruit after major damage e.g. from fire, but applicable only if species regularly resprouts. The time required to accumulate a seedbank sufficient to ensure reasonable recruitment in the event of mass mortality is also an important consideration. Primary and secondary juvenile periods should not be considered as absolute and they may vary spatially as a function of habitat factors (moisture availability, nutrients etc.) and temporally (e.g. climatic variation).

Source: literature, field observations.

**Reproduction**: for Angiosperms, reproduction is separated into:

**Flowers**: predominant flower colour, flowering period — range of months and, where possible, peak month based on frequency of herbarium collections. Pollination vectors.

**Fruit**: fruit shape and size, particularly with respect to potential dispersal agents. Maturation period. Seed size and number.

Source: Herbarium specimens, field observations, *Flora of New South Wales,* literature.

**Dispersal, establishment and growth**: diaspore type (including vegetative), dispersal agent. Germination requirements: seedbank presence, dormancy, growth rates, seasonality, deciduousness etc. [notes on propagation in cultivation may be given where these imply similar behaviour under natural field conditions e.g. insights into seed germination inhibition].

Source: literature, field observations.

**Fire response**: general response of mature plant to fire, in particular whether it generally resprouts or is killed (see also Gill 1981, Gill & Bradstock 1992). Seedling recruitment associated with fire is included under establishment and growth. Entries such as 'probably killed' mean that a species has no obvious morphological characteristics likely to assist in surviving and resprouting following fire. While species that resprout after fire may be readily noted, the death of individuals may not be observed unless the occurrence of the species in the area was well known prior to the fire.

For a given species some populations may be capable of resprouting while other populations may be killed. This may explain cases where contradictory evidence has been given though response to fire in some species may depend on fire intensity.

In view of the limited information available for many species, the categories of Gill and Bradstock (1992) have not been applied at this stage.

Source: field observations, literature.

**Interaction with other organisms**: symbiosis, predators, diseases etc.

Source: mainly literature.

## Distribution

**Status/origin**: native or naturalised, region of origin, source and date of introduction/ naturalisation. Naturalised species indicated by an asterisk following the botanical name.

Source: *Flora of New South Wales*, literature.

**Botanical subregions**: occurrence of species in botanical subdivisions of NSW, other states and countries.

Source: National Herbarium of New South Wales.

**Distribution in Sydney region**: main geographic regions occupied by species.

Source: Herbarium specimen records.

**Selected locations**: restricted to about 10 localities for each taxon reflecting natural geographical range of species in the Sydney area. Earliest collection dates are given for some species, particularly exotic species. Recent collection sites indicated where possible. Locality data must be interpreted carefully. The record may be based on an old specimen or observation record and the species may no longer be present at the site. However a knowledge of the original distribution may be important in showing up particular habitat requirements of the species.

Source: Herbarium specimen records.

## Habitat

Specific data refer to Sydney area unless stated otherwise.

**Habitat**: brief generalised description.

Source: Herbarium specimen records, field observations.

**Altitude**: approximate altitudinal range (m +/- 100 m) occupied by the species,

Source: Herbarium specimen records.

**Annual rainfall**: approximate annual rainfall range (mm +/- 100 mm) for sites occupied by the species.

Source: Bureau of Meteorology (1979).

**Typical local abundance**: most frequent recordings (scale: dominant/frequent/ occasional/rare)

Source: Herbarium specimen records.

**Vegetation**: main structural type with typical associated species where available.

Source: Herbarium specimen records, field observations, literature.

**Substrate**: geology, soil, moisture supply.

**Soil nutrient rating scale**: very fertile (high nutrient) (e.g. basalt soils)/ fertile (moderate nutrient)/ infertile (low nutrient)/ very infertile (very low nutrient) (e.g. sands).

**Soil salinity scale**: hypersaline/ saline/ brackish/ fresh.

Source: Herbarium specimen records, field observations, literature.

**Exposure**:

Exposure scale: exposed/ indifferent/ sheltered.

Shading scale: deep shade/ mid shade/ light shade/ no shade.

Source: Herbarium specimen records, field observations, literature.

## Conservation

**Conservation**: listing as Endangered or Vulnerable, or as Endangered Population on schedules of the NSW *Threatened Species Conservation Act 1995*; national significance listing (Briggs & Leigh 1996), Rare or Threatened Australian Plants (ROTAP) database; comments on regional significance and adequacy of conservation within Sydney area are based on authors' knowledge of the abundance of species and their primary occurrence in major conservation areas. These comments apply to the Sydney region; a species may be common or rare elsewhere. 'Probably' is used in many cases as it is the authors' views that a definite categorisation of 'adequately conserved' needs to be based on a better knowledge of the species' biology and distribution than we have at present for most species.

Source: Herbarium records, field observations, literature.

## General comments on part 9

Part 9 covers 361 plant species of the monocotyledon families Agavaceae to Juncaginaceae, 260 native and 101 naturalised exotics.

Plant families in this part are Agavaceae, Alismataceae, Alliaceae, Alstroemeriaceae, Amarylidaceae, Anthericaceae, Aponogetonaceae, Araceae, Arecaceae, Asparagaceae, Asphodelaceae, Asteliaceae, Blandfordiaceae, Burmanniaceae, Cannaceae, Centrolepidaceae, Colchicaceae, Commelinaceae, Cyperaceae, Dioscoreaceae, Doryanthaceae, Eriocaulaceae, Flagellariaceae, Haemodoraceae, Hyacinthaceae, Hydrocharitaceae, Hypoxidaceae, Iridaceae, Juncaceae, Juncaginaceae. Very little ecological work has been done on these groups.

Excluded from this work are a number of exotic species that do not appear to be truly naturalised in the Sydney region (*Agave americana, Allium neopolitanum, Allium oleraceum, Aloe maculata, Amaryllis belladonna, Anomatheca laxa, Callisia fragrans, Cyperus bowmannii, Cyperus papyrus, Ipheion uniflorum, Ixia polyotachya, Leucojum aestivum, Moraea miniata, Narcissus pseudonarcissus, Ornithogalum longibracteatum, Ornithogalum umbellatum*).

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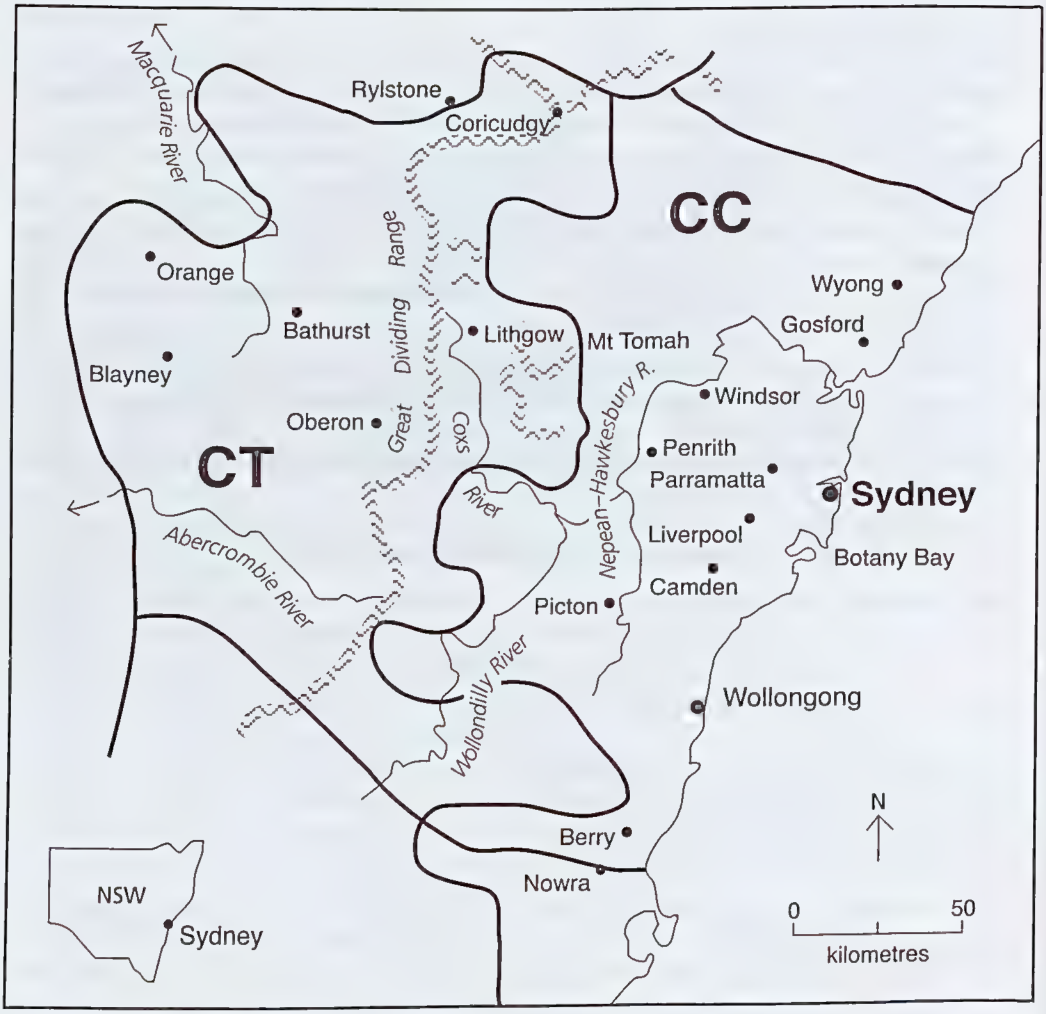

## Map of the Sydney region

For the Ecology of Sydney Plant Species the Sydney region is defined as the Central Coast and Central Tablelands botanical subdivisions.

## Monocotyledon families Agavaceae to Juncaginaceae

### *Furcraea foetida* * AGAVACEAE

Mauritius Hemp

**Life history**

**Growth form:** Shrubby plant, with tufted succulent leaves and stem to 50 cm high.
**Vegetative spread:** Spread by bulbils.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Whitish–greenish, autumn.
**Fruit/seed:** Capsule with flattened seeds, although fruit not formed here in NSW.
**Dispersal, establishment & growth:** Vegetative dispersal by bulbils which develop on flowering branches after flowers have fallen.
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to northern S America, Introduced as ornamental.
**Botanical subregions:** NC CC; LHI, Qld, W.A.
**Distribution Sydney area:** Sydney Harbour.
**Select locations:** CC: Bradleys Head (1965).

**Habitat**

**Habitat:**
**Altitude:** 0–50 m **Annual rainfall:** 1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Eucalypt woodland.
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:**

**Conservation**

**Conservation:** Naturalised in bushland around foreshores of Sydney Harbour, particularly Mosman (Harden 1993), crowding out native species.

## *Alisma plantago-aquatica* ALISMATACEAE

Water Plantain

### Life history

**Growth form:** Erect emergent aquatic perennial to 1.5 m tall.
**Vegetative spread:** No.
**Longevity:** Probably short.
**Primary juvenile period:**
**Flowers:** Flowers December–April after rapid vegetative growth in spring. Flowers open for one day then shrivel. Insect-pollinated (Cook 1990).
**Fruit/seed:** Head of one-seeded nutlet which fall singly on maturity, December–April. Seed size 0.7 mm, weight 0.33 mg (Shipley & Parent 1991).
**Dispersal, establishment & growth:** Diaspore: nutlet, buoyant for some time to aid dispersal by water. Seeds germinate readily in moist soil (Sainty & Jacobs, 1981). Germination 2% within 30 days in North America (Shipley & Parent 1991). Rapid growth in spring. Coloniser.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CT ST SWS SWP; Vic., Eur.
**Distribution Sydney area:** Cumberland Plain, Illawarra, Western Blue Mtns.
**Select locations:** **CC:** Maroota, Longneck Lagoon, Richmond, Glenbrook Creek, Casula, Albion Pk, Gerringong. **CT:** Abercrombie River, Wombeyan Caves.

### Habitat

**Habitat:** Coast, beside creeks, lakes & swamps in water to 50 cm deep. Also in drying mud.
**Altitude:** 0–800 m **Annual rainfall:** 800–1200 mm.
**Typical local abundance:** Occasional.
**Vegetation:** Wetland species e.g. with *Paspalum distichum.*
**Substrate:** Alluvium, medium nutrients, seedlings establish in moist soil but adults survive in water up to 50 cm deep. Also persists in drying mud.
**Exposure:** Full sun.

### Conservation

**Conservation:** Widespread but not common. Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Damasonium minus* ALISMATACEAE

Star-fruit

### Life history

**Growth form:** Erect emergent aquatic herb to 1 m high.
**Vegetative spread:** No.
**Longevity:** Annual or short-lived perennial.
**Primary juvenile period:** Probably less than 1 year.
**Flowers:** November-December (SW NSW).
**Fruit/seed:** Fruit any time of year. Fruiting carpels eventually fall singly.
**Dispersal, establishment & growth:** Diaspore: seed; no specialised appendage on dispersal unit. Germination in glasshouse summer and autumn (Britton & Brock 1994).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CWS SWS NWP; Qld, Vic., Tas., N.T., S.A., W.A.
**Distribution Sydney area:** Western Sydney.
**Select locations:** **CC:** Richmond, Glenfield, Casula, Erskine Park, Camden, Menangle.

### Habitat

**Habitat:** Wet pastures and margins of ponds.
**Altitude:** 0–200 m **Annual rainfall:** 800–1000 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Emergent wetland vegetation e.g. *Juncus, Typha, Persicaria.*
**Substrate:** Stationary or slowly flowing ephemeral or permanent fresh water up to 30 cm deep over mud, generally derived from Wianamatta Shale, medium nutrients. Water table mostly high, fresh.
**Exposure:** No shade.

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Sagittaria platyphylla* * *(S. graminea* subsp. *platyphylla)* ALISMATACEAE

Sagittaria

### Life history

**Growth form:** Emergent, rhizomatous aquatic perennial herb, with root tubers to 4 cm long.
**Vegetative spread:** Rhizomes, floating mats will take root in suitable locations (Sainty & Jacobs 1981).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White, mostly separate male and female flowers, January to late autumn.
**Fruit/seed:** Head of nutlets. Fruit in autumn or early winter (Sainty & Jacobs 1981, Parsons & Cuthbertson 1992).
**Dispersal, establishment & growth:** Diaspore: seed, but dispersal is mainly vegetative by rhizomes, tubers and floating mats; seeds germinate in spring, with rhizomes appearing about one month later; optimum growth temperature 24°C; tuber and rhizome formation appears to be controlled by intensity and quality of light (Parsons & Cuthbertson 1992).
**Fire response:**
**Interaction with other organisms:** Ducks eat tubers and seeds, which are believed to be viable when excreted (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to America. Introduced as ornamental.
**Botanical subregions:** CC ST SWP; Qld, Vic., S.A., W.A.
**Distribution Sydney area:** Sydney suburban area.
**Select locations:** **CC:** East lakes (1990), Picnic Point (1985), Turrella (1988).

### Habitat

**Habitat:** Creeks, ponds.
**Altitude:** 0–50 m **Annual rainfall:** 1000–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:** Shallow water over alluvium and sand.
**Exposure:**

### Conservation

**Conservation:** Widely cultivated as ornamental (Sainty & Jacobs 1981). Widespread around Sydney. Probably likely to spread.

## *Agapanthus praecox* subsp. *orientalis* * ALLIACEAE

### Life history

**Growth form:** Clump-forming perennial herb with broad, almost evergreen, dark green leaves (Readers Digest 1992).
**Vegetative spread:** Yes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Blue, summer.
**Fruit/seed:** Capsule.
**Dispersal, establishment & growth:** Diaspore: seed, and spread vegetatively from root fragments in dumped garden refuse (J. Hosking pers. comm.).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa, introduced as ornamental (J. Hosking pers. comm.).
**Botanical subregions:** CT; Vic., W.A.
**Distribution Sydney area:** Blue Mountains.
**Select locations:** CT: Katoomba.

### Habitat

**Habitat:**
**Altitude:** 800–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:**
**Vegetation:** Eucalypt woodland.
**Substrate:** Sandy soils on sandstone, low nutrients.
**Exposure:** Full sun.

### Conservation

**Conservation:** Spreading below plantings at Three Sisters, Katoomba, and reported spreading in other areas of Blue Mountains (J. Hosking pers. comm., 2002).

## *Allium ampeloprasum* * ALLIACEAE

Great-head Garlic

### Life history

**Growth form:** Erect herb to 110 cm high, with a bulb 10–35 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to pink, summer.
**Fruit/seed:** Capsule 4 mm long, with 3–6 seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Widely eaten and used medicinally (Harden 1993).

### Distribution

**Status/origin:** Exotic, native to Mediterranean region. Introduced as ornamental.
**Botanical subregions:** CC CT; Vic., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** CC: Cheltenham (1950). CT: Orange (1970).

### Habitat

**Habitat:** Railway lines, old cultivation sites, drainage channels.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:** Alluvium and agricultural areas.
**Exposure:**

### Conservation

**Conservation:** Widely cultivated. Infrequently naturalised and probably not likely to invade bushland.

## *Allium triquetrum* * ALLIACEAE

Three-cornered Garlic, Angled Onion

### Life history

**Growth form:** Erect herb 18–40 cm high, with bulb 7–15 mm diam. and bulblets. Crushed leaves have strong onion smell.
**Vegetative spread:** By bulblets.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White to pink, August–November.
**Fruit/seed:** Capsule 6–7 mm long.
**Dispersal, establishment & growth:** Vegetative spread by bulblets, possibly dispersed by water, also dispersed in garden waste.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to W. Mediterranean region. Introduced as ornamental.
**Botanical subregions:** NC CC NWS CWS SWS SWP; Qld, Vic., Tas, S.A., W.A.
**Distribution Sydney area:** Suburban areas.
**Select locations:** **CC:** Lindfield, Northbridge (1952), Mosman, South Coogee, Bondi, Leura (JH).

### Habitat

**Habitat:** Headlands, along creeks, shady slopes.
**Altitude:** 0–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Weedy sites often associated with old gardens.
**Substrate:** Sandy soil, low nutrients.
**Exposure:** Mid to light shade.

### Conservation

**Conservation:** Commonly cultivated. Invasive along creeks. Widespread in southern Australia (Parsons & Cuthbertson 1992).

## *Nothoscordum borbonicum* * *(N. inodorum, N. gracile)* ALLIACEAE

Onion Weed

### Life history

**Growth form:** Erect herb 45–105 cm high, with contractile roots pulling aging individuals deeper into soil.
**Vegetative spread:** Numerous bulblets arising from main bulb, easily dislodged enabling vegetative spread.
**Longevity:**
**Primary juvenile period:** Probably 2–3 years.
**Flowers:** White, September–December. Flowers visited by Honeybees *Apis mellifera* and Hoverfly (Syrphidae) (P. Kubiak pers. comm.).
**Fruit/seed:** Capsule 7–8 mm long, with black seed 0.5 mm diam.
**Dispersal, establishment & growth:** Diaspore: seed, rolls easily into crevices etc., also dispersed by bulblets.
**Fire response:** Probably resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), fruiting in 18 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S. America.
**Botanical subregions:** NC CC SC CT ST NWS CWS SWS NWP SWP; LHI, Qld, Vic., Tas., S.A., W.A..
**Distribution Sydney area:** Widespread in suburban areas.
**Select locations:** CC: Flemington Saleyards (1969).

### Habitat

**Habitat:** Gardens, river edges, estuarine flats.
**Altitude:** 0–200 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** Weedy areas.
**Substrate:** Clay soils on shale, alluvium, also on sandstone, often damp sites e.g. floodplain soils.
**Exposure:** Full sun to mid-shade.

### Conservation

**Conservation:** Widespread and common weed in gardens, difficult to eradicate as the bulblets are easily dislodged.

## *Alstroemeria pulchella** *(A. psittacina)* ALSTROEMERIACEAE

Parrot Alstroemeria

### Life history

**Growth form:** Herb with many simple leafy stems to 1 m long, arising annually from rhizome, also has tuberous rootstock.
**Vegetative spread:** By rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** November–May. Honeybees feed on nectar (P. Kubiak pers. comm.).
**Fruit/seed:** Ribbed capsule 10–15 mm diam., with numerous reddish brown seeds 3 mm diam.
**Dispersal, establishment & growth:** Not clear if seed is fertile; main spread is by rhizome.
**Fire response:** Probably resprouted after high intensity fire 1994 (at Lane Cove), fruiting in less than 1 year (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to C & S America, introduced as ornamental.
**Botanical subregions:** NC CC; Qld, W.A.
**Distribution Sydney area:** Suburban areas.
**Select locations:** CC: Kangaroo Point (1950), Clifton Gardens (1997), Woollahra (1983).

**Habitat**

**Habitat:** Shady sites, old gardens.
**Altitude:** 0–200 m **Annual rainfall:** 1100–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Spreading into eucalypt woodland e.g. with *Angophora costata, Corymbia gummifera.*
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:** Mid shade.

**Conservation**

**Conservation:** Cultivated as ornamental. Sometimes naturalised in shady sites in coastal districts as escapees from gardens or rubbish dumping.

## *Crinum pedunculatum* AMARYLLIDACEAE

Swamp Lily, River Lily

**Life history**

**Growth form:** Herbaceous plant 50 cm high, with fleshy, linear, dark green basal leaves and spidery flowers (Smith 1999). This species is perhaps conspecific with *Crinum asiaticum,* a complex needing further study (Du Puy & Telford 1993).
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White, scented, summer. Insect-pollinated (Cook 1990).
**Fruit/seed:** Seeds are spongy in texture, silvery or green, 25–40 mm diam., with long viability (Smith 1999), surrounded by corky skin which is impervious to water (Carolin & Clarke 1988).
**Dispersal, establishment & growth:** Diaspore: seeds, flushed by flood rains from swampy places to beach areas where they are often found beginning to germinate, but damp conditions are needed for root development (Smith 1999).
**Fire response:**
**Interaction with other organisms:** Bulb is edible after cooking (Smith 1999).

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; LHI, Qld, N.T., N.G., Keeling Is, N. Cal, Fiji, Timor.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Port Jackson, Minnamurra River.

**Habitat**

**Habitat:** Coastal swamps, along streams, beaches.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1600 mm
**Typical local abundance:** Occasional.
**Vegetation:** Strandline vegetation, estuarine.
**Substrate:** Sandy soils on sandy alluvium, low nutrients. On sand dunes along seepage lines (Carolin & Clarke 1988).
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown, Jervis Bay is southern geographical limit. Frequently cultivated.

## *Zephyranthes candida* * AMARYLLIDACEAE

White Rain Lily

### Life history

**Growth form:** Perennial herb with basal leaves.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, tinged with pink, March.
**Fruit/seed:** Capsule 10 mm diam., with flat D-shaped black seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America. Introduced as ornamental.
**Botanical subregions:** NC CC ?NWS; Qld. native to S America
**Distribution Sydney area:**
**Select locations:** CC: Marayong (1972), Albion Park (1964), Berry (1990).

### Habitat

**Habitat:** Cultivated land, cemeteries.
**Altitude:** 0–200 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:**
**Vegetation:** Grassland.
**Substrate:** Clay soils.
**Exposure:**

### Conservation

**Conservation:** Cultivated, occasionally reported naturalised in disturbed situations (Harden 1993).

## *Alania endlicheri* ANTHERICACEAE (LILIACEAE)

### Life history

**Growth form:** Rhizomatous perennial herb rooting at nodes, with flowering stems 30 cm high; leaves narrow, to 12 cm long, densely crowded along stems.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White, November–January.
**Fruit/seed:** Capsule 2.5–3 mm., with ovoid, smooth, black fine seeds, November–May.
**Dispersal, establishment & growth:** Diaspore: seed, probably wind-dispersed.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC CT.
**Distribution Sydney area:** Blue Mountains–Watagans.
**Select locations:** **CC:** Watagan Mountains, Brisbane Water NP, Linden. **CT:** Mt Coricudgy, Kurrajong Heights, Bilpin, Mount Tomah, Wentworth Falls, Lawson, Woodford.

### Habitat

**Habitat:** Rock faces, clifftops.
**Altitude:** 0–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Cliffline vegetation e.g. with *Dracophyllum secundum, Epacris crassifolia;* associated with rainforest e.g. with *Ceratopetalum apetalum, Doryphora sassafras;* moist eucalypt open-forest.
**Substrate:** Cracks in moist sandstone rock faces, low nutrients.
**Exposure:** Mid-shade.

### Conservation

**Conservation:** Rare in Watagans and Gosford area but more common in Blue Mountains. Conservation status unknown. Reported in Brisbane Water NP.

## *Arthropodium milleflorum* ANTHERICACEAE (Liliaceae)

*(Arthropodium paniculatum)*

### Life history

**Growth form:** Perennial herb, with tubers 2–3 cm long; leaves long, narrow and usually glaucous.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White to pale blue to pink, October–March.
**Fruit/seed:** Capsule 4–5 mm diam., with black seeds, October–May.
**Dispersal, establishment & growth:** Diaspore mobile (McIntyre et al. 1995), no special morphology (Westoby et al. 1990).
**Fire response:**
**Interaction with other organisms:** Palatable to rabbits (Leigh et al. 1987).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS ?NWP ?SWP; ?Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Mooney Mooney, St Albans, Pitt Town, Berowra, Barrenjoey, Bayview, Glenbrook, Faulconbridge, Quakers Hill, Rookwood, Oatley, Kogarah, Macquarie Fields, Mount Annan. **CT:** Jenolan Caves, Kowmung River, Wingello (1899).

### Habitat

**Habitat:** Hillsides, slopes, creekbanks.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus dives, E. fastigata;* woodland e.g. with *Eucalyptus crebra, E. tereticornis, E. moluccana;* semi-rainforest.
**Substrate:** Clay to sandy soils on shale, sandstone, volcanic necks, low to medium nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Reported in Kanangra Boyd NP.

## *Arthropodium minus* ANTHERICACEAE (LILIACEAE)

### Life history

**Growth form:** Perennial herb, with sessile tubers 2 cm long; leaves long and narrow.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to purple, September–December.
**Fruit/seed:** Capsule 4 mm diam., with black seeds. Seed weight: 960 seeds per gram (Morgan & Lunt 1994). Mature January–February.
**Dispersal, establishment & growth:** Examination showed 98% seeds viable, but in experiment, germination was very low in conditions of light and dark with both constant and alternating temperature (Morgan & Lunt 1994). Germination after storage 2–3 months takes approx. 35 days, with about 32 seedlings per gram seed; high temperatures inhibit germination (Greening Australia 1996b).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP; Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Western Sydney, Orange–Rylstone.
**Select locations:** **CC:** Scheyville, Camden, Wongawilli. **CT:** Rylstone, Coricudgy.

### Habitat

**Habitat:**
**Altitude:** 0–1000 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest to woodland e.g. with *Eucalyptus saligna, E. pilularis, E. crebra, E. tereticornis, E. moluccana, E. melliodora, E. albens.*
**Substrate:** Clay soil on shale, basalt, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Caesia alpina* *(Chlorophytum alpinum)* ANTHERICACEAE (LILIACEAE)

Alpine Grass-lily

### Life history

**Growth form:** Tufted perennial herb, with branched rhizome and fleshy-fibrous roots.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Greenish white, December.
**Fruit/seed:** Lobed capsule 6 mm diam., with black seeds 2 mm diam., December.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic., Tas.
**Distribution Sydney area:** Southern Highlands.
**Select locations:** **CT:** Wingecarribee Swamp

### Habitat

**Habitat:** Edge of montane peatland.
**Altitude:** 700 m **Annual rainfall:** 1600 mm
**Typical local abundance:** Rare.
**Vegetation:** Sedgeland e.g. with *Leptospermum obovatum, Pultenaea divaricata.*
**Substrate:** Probably clay soils on alluvium, medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Rare, only recorded at one site in Sydney area.

## *Caesia parviflora* var. *minor* ANTHERICACEAE (LILIACEAE)

### Life history

**Growth form:** Tufted, perennial herb, less than 20 cm high, with rhizome and clustered fleshy or tuberous roots.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White mainly, also blue or purple, January.
**Fruit/seed:** 3-lobed capsule to 5 mm diam., with black seeds 2 mm diam., January.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CT CWS; Vic., Tas.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** CT: Mt Wilson.

### Habitat

**Habitat:**
**Altitude:** 1100 m **Annual rainfall:** 1400 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Probably sandstone soil.
**Exposure:**

### Conservation

**Conservation:** Rare, only one record for area, Mt Wilson to Bell in 1904. Listed as Endangered (Schedule I) NSW *Threatened Species Conservation Act 1995.*

## *Caesia parviflora* var. *parviflora* ANTHERICACEAE (Liliaceae)

### Life history

**Growth form:** Tufted, perennial herb, usually more than 20 cm high, with rhizome and clustered fleshy or tuberous roots.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to pale pink or blue, October–January. Flowers appear to close in the morning, open in the afternoon and close in late afternoon to re-open the next day; probably pollinated by native bees and possibly flies (Diptera) (P. Kubiak pers. comm.).
**Fruit/seed:** 3-lobed capsule 5 mm diam., with black seeds 2 mm diam., December–January.
**Dispersal, establishment & growth:** Diaspore: seed with ant-adapted food body for dispersal (Westoby et al. 1990).
**Fire response:** Resprouts, secondary juvenile period 1 year; recruitment mainly after fire (D. Keith pers. comm.).
**Interaction with other organisms:** Leaves eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT NWS SWS; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Putty, Bowen Mountain, Pitt Town, Cheltenham, Dee Why, Manly, Maddens Plains, Yallah, Carringon Falls, Nowra. **CT:** Springwood, Bindook.

### Habitat

**Habitat:** Ridges, slopes.
**Altitude:** 0–700 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus sieberi, E. piperita, Corymbia gummifera, E. sclerophylla.*
**Substrate:** Sandy soil on sandstone, occasionally on clay soils, low–medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Caesia parviflora* var. *vittata* (*C. vittata*) ANTHERICACEAE (Liliaceae)

### Life history

**Growth form:** Tufted, perennial herb, usually more than 20 cm high, with rhizome and clustered fleshy or tuberous roots.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Blue, October–November, February–April.
**Fruit/seed:** 3-lobed capsule to 5 mm diam., with black seeds 2 mm diam. Myrmecochore (Rice & Westoby 1981), December, February–March.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Qld, Vic.
**Distribution Sydney area:**
**Select locations:** **CC:** Glen Davis, Kedumba, Wyong, Somersby, Pitt Town, Barrenjoey, Belrose, Dee Why, Mount Annan. **CT:** Bathurst.

**Habitat**

**Habitat:** Hillsides, ridges.
**Altitude:** 0–600 m **Annual rainfall:** 600–1200 mm
**Typical local abundance:** Occasional–frequent.
**Vegetation:** Woodland e.g. with *Eucalyptus crebra, E. tereticornis, E. moluccana, E. sclerophylla, Angophora bakeri, Corymbia gummifera, Banksia serrata;* scrub e.g. with *Angophora hispida, Leptospermum trinervium, Banksia ericifolia; Melaleuca* swamp.
**Substrate:** Clay to sandy soils on shale, sandstone, low to medium nutrients, well-drained to periodically moist.
**Exposure:**

**Conservation**

**Conservation:** Conserved in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Chlorophytum comosum* * *(Anthericum comosum)* ANTHERICACEAE (LILIACEAE)

Spider Plant

**Life history**

**Growth form:** Tufted perennial herb to 60 cm high, with tuberous roots 5–10 cm long.
**Vegetative spread:** Leafy plantlets at top of drooping inflorescences take root when in contact with soil.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Green or white, summer. Honeybee *Apis mellifera* gathered pollen (P. Kubiak pers. comm.).
**Fruit/seed:** 3-lobed capsule 4–10 mm long, with flattish brown or black seeds.
**Dispersal, establishment & growth:** Local vegetative spread is by plantlets. The importance of seed dispersal and establishment is not known.
**Fire response:** Probably resprouted after high intensity fire 1994 (at Lane Cove), with immature fruit in 16 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** CC; LHI, Qld.
**Distribution Sydney area:**
**Select locations: CC:** Beecroft (1952), Clifton Gardens (1997), Naremburn (1965), Parramatta (1951).

**Habitat**

**Habitat:** Gullies, creeks.
**Altitude:** 0–100 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Moist forest e.g. *Eucalyptus pilularis, Angophora costata, Syncarpia glomulifera.*
**Substrate:** Clay soils on shale, alluvium, medium nutrients.
**Exposure:**

**Conservation**

**Conservation:** Widely cultivated, occasionally naturalised near suburban areas, probably from garden escapes or rubbish dumping. Reported in Sydney Harbour NP.

## *Dichopogon fimbriatus* (*Arthropodium fimbriatum*) ANTHERICACEAE (LILIACEAE)

Nodding Chocolate Lily

### Life history

**Growth form:** Erect herb to 1 m high, with fibrous roots to 9 cm ending in spindle-shaped tubers; leaves long and narrow.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Purplish, September–February.
**Fruit/seed:** Capsule 5–7 mm long, with black seeds.
**Dispersal, establishment & growth:** No particular mechanism for dispersal (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT CT ST NWS CWS SWS NWP SWP SFWP; Qld, Vic., S.A., W.A.
**Distribution Sydney area:** Mainly western Sydney.
**Select locations:** **CC:** Agnes Banks, Scheyville, Quakers Hill, Mount Annan. **CT:** Wingello.

### Habitat

**Habitat:** Grassy woodland.
**Altitude:** 0–800 m **Annual rainfall:** 700–800 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus fibrosa, E. crebra, E. sclerophylla, E. moluccana.*
**Substrate:** Sandy to clayey soils on Tertiary alluvium, Wianamatta Shale, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown. Only record for Central Tablelands is Wingello in 1899.

## *Dichopogon strictus* (*Arthropodium strictum*) ANTHERICACEAE (LILIACEAE)

Chocolate Lily

### Life history

**Growth form:** Erect herb to 1 m high, with fibrous roots to 9 cm long, ending in spindle-like tubers; one flower per node.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Purple, August–January.
**Fruit/seed:** Mature January–February;
**Dispersal, establishment & growth:** Germination after storage 2–3 months takes approx. 71 days, with about 354 seedlings per gram seed; high temperatures inhibit germination (Greening Australia 1996b).
**Fire response:**
**Interaction with other organisms:** Tubers eaten by Aboriginal people (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT CT ST NWS CWS SWS NFWP SFWP; Qld, Vic., S.A., N.G.
**Distribution Sydney area:** Bathurst area.
**Select locations:** **CC:** St Marys (1887). **CT:** Bathurst Plains (1822), O'Connell (1995).

### Habitat

**Habitat:**
**Altitude:** 700–800 m **Annual rainfall:** 600–700 mm
**Typical local abundance:**
**Vegetation:** Open-forest.
**Substrate:** Shallow skeletal soil.
**Exposure:**

### Conservation

**Conservation:** Rare in Bathurst area. Vulnerable in Western Sydney (James et al. 1999).

## *Laxmannia compacta* ANTHERICACEAE (Liliaceae)

### Life history

**Growth form:** Spreading, stoloniferous herb to 10 cm high, with narrow leaves in tufts along stems.
**Vegetative spread:** Stoloniferous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** White–pink, opening at night, August–November.
**Fruit/seed:** Capsule 2-3 mm diam., with 3–12 dull black seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT NWS CWS; Qld.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Cheltenham (1954), Willmot (1987).

### Habitat

**Habitat:**
**Altitude:** 0–300 m **Annual rainfall:** 800–1200 mm
**Typical local abundance:** Rare.
**Vegetation:** Woodland e.g. with *Eucalyptus fibrosa, Allocasuarina littoralis.*
**Substrate:** Clay loam on Tertiary alluvium, shale, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Rare, only 2 records for Sydney area.

## *Laxmannia gracilis* ANTHERICACEAE (Liliaceae)

### Life history

**Growth form:** Erect, tufted, rhizomatous herb to 40 cm high, with stilt-like and fibrous roots.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pink–white, opening at night, October–March, peak November.
**Fruit/seed:** Capsule 3 mm diam., with 3–12 dull black seeds, October–March.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS NWP; Qld, Vic., S.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Putty, Morisset, Colo Heights, Pitt Town, St Marys, Wisemans Ferry, Barrenjoey, Hornsby, Church Point, Lane Cove, Kogarah, Rookwood, Springwood, Tahmoor, Bomaderry. **CT:** Mt Boonbourwa, Cargo, Newnes Plateau, Mt Victoria, Katoomba, Barbers Creek, Taralga.

### Habitat

**Habitat:** Ridges, gentle slopes.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus fibrosa, E. crebra, E. sclerophylla, Angophora bakeri, Melaleuca decora, Melaleuca nodosa; open-forest e.g. with Eucalyptus dives, E. macrorrhyncha, Acacia falciformis.*
**Substrate:** Soil from granite or sandstone, clay soil on shale, Tertiary alluvium, sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Wollemi NP, Brisbane Water NP, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Royal NP.

## *Sowerbaea juncea* ANTHERICACEAE (LILIACEAE)

Rush Lily, Vanilla Plant

### Life history

**Growth form:** Tufted perennial herb, with fibrous roots.
**Vegetative spread:** No.
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** Lavender–pink–white, July–December, peak October.
**Fruit/seed:** Capsule 2–3 mm diam., with brown to black seeds, October–January.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990). Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts from base, flowers next spring. Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.), flowering in 32 weeks after high intensity fire 1994 (at Narrabeen, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS SWS; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread, mainly on coast.
**Select locations:** **CC:** Cooranbong, Somersby, Berowra, Rose Bay, Long Bay, Cape Solander, Warumbul Road Royal NP. **CT:** Clarence, Lithgow, Mt Wilson, Blackheath, Mittagong, Carrington Falls, Wingecarribee Swamp, Penrose State Forest.

### Habitat

**Habitat:** Wet heath.
**Altitude:** 0–1100 m **Annual rainfall:** 1100–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Banksia ericifolia; scrubby woodland* e.g. with *Eucalyptus sieberi, E. piperita, E. stricta;* sedgeland e.g. with *Restio, Xyris, Gahnia.*
**Substrate:** Shallow soils on sandstone, intermittently waterlogged soils, low nutrients.
**Exposure:** Full sun.

### Conservation

**Conservation:** Conservation status unknown. Reported in Bouddi NP, Brisbane Water NP, Ku-ring-gai Chase NP, Garigal NP, Royal NP.

## *Thysanotus juncifolius* ANTHERICACEAE (LILIACEAE)

### Life history

**Growth form:** Herb with small rhizome and fibrous roots, leaves withering before flowering.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Mauve to blue, September–March, peak January.
**Fruit/seed:** Capsule 4 mm diam., with black seeds, December–March.
**Dispersal, establishment & growth:** Ant-adapted food body for dispersal (Westoby et al. 1990).
**Fire response:** Resprouts, seedlings established (at Bundeena, Herb. note), flowering 17 weeks after high intensity fire 1994 (at Narrabeen, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST; Vic., S.A.
**Distribution Sydney area:** Coast and Upper Blue Mountains.
**Select locations:** **CC:** Peats Ridge, Belrose, Oatley, Stanwell Park. **CT:** Bilpin, Mt Wilson, Katoomba, Robertson.

**Habitat**

**Habitat:** Swampy situations.
**Altitude:** 0–1000 m **Annual rainfall:** 1100–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Banksia ericifolia, Banksia oblongifolia, Xyris, Anisopogon avenaceus, Lepidosperma laterale;* woodland e.g. with *Angophora bakeri, Corymbia gummifera, Angophora hispida.*
**Substrate:** Peaty sand to sandy soil over sandstone, periodically wet, low nutrients.
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Thysanotus patersonii* ANTHERICACEAE (LILIACEAE)

Twining Fringe-lily

**Life history**

**Growth form:** Twining or prostrate herb, roots tuberous 1–5 cm long, leaves annual.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Mauve to blue, September–November.
**Fruit/seed:** Capsule 3–4 mm diam., with black seeds, mature summer.
**Dispersal, establishment & growth:** Diaspore: seed, germination takes 28–42 days, with high germination rate (Greening Australia 1996b). New tubers develop annually during growing season (Bindon 1996).
**Fire response:**
**Interaction with other organisms:** Tuberous roots eaten by Aboriginal people (Cribb & Cribb 1984).

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** SC CT ST NWS CWS SWS NWP SWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A.
**Distribution Sydney area:** Bathurst–Carcoar.
**Select locations:** CT: Carcoar Cemetery (1991), Bathurst (1986), Mt York (1985).

**Habitat**

**Habitat:**
**Altitude:** 600–1000 m **Annual rainfall:** 600–800 mm
**Typical local abundance:** Rare.
**Vegetation:** Woodland e.g. with *Eucalyptus albens, E. polyanthemos, E. macrorrhyncha, E. goniocalyx, E. blakelyi.*
**Substrate:** Clay soil on diorite.
**Exposure:**

**Conservation**

**Conservation:** Rare, only three records in the area, including undisturbed woodland near cemetery (Carcoar).

## ***Thysanotus tuberosus*** subsp. ***tuberosus*** **ANTHERICACEAE** (LILIACEAE)

Common Fringe-lily

### Life history

**Growth form:** Erect herb with rhizome and tubers 1–3 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Mauve to blue, November–February.
**Fruit/seed:** Capsule 3–7 mm diam., with black seeds. Mature summer (Greening Australia 1996b).
**Dispersal, establishment & growth:** Ant-adapted food body for dispersal (Westoby et al. 1990). Germination approx. 28–42 days, with high germination rate (Greening Australia 1996b).
**Fire response:** Stems killed, resprouts from base, flowers immediately after fire. Secondary juvenile period 1 year.
**Interaction with other organisms:** Tuberous roots eaten by Aboriginal people (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., S.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Llandillo, Pennant Hills, Willmot, Clyde, Mortdale, Kurnell, Casula, Thirlmere, Yerrinbool, Bomaderry, W Cambewarra. **CT:** Clarence, Jenolan Caves, Mittagong, Bundanoon, Penrose SF.

### Habitat

**Habitat:** Heath, woodland.
**Altitude:** 0–1100 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Eucalypt woodland e.g. with *Eucalyptus tereticornis, E. sideroxylon, Melaleuca* species; tall heath e.g. with *Banksia integrifolia.*
**Substrate:** Clay loam to peaty sandy loam on alluvium, sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Botany Bay NP.

## ***Thysanotus virgatus*** **ANTHERICACEAE** (LILIACEAE)

### Life history

**Growth form:** Leafless herb 30–40 cm high, with small rhizomes and fibrous roots; it may be inconspicuous when not flowering (D. Keith pers. comm.).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pale purple, November–January.
**Fruit/seed:** Capsule 3–4 mm diam., with black seeds, November–January.
**Dispersal, establishment & growth:**
**Fire response:** Resprouts, flowering within one year of fire (D. Keith pers. comm.). Resprouts from base, seedlings (at Bundeena, Herb. note).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC.
**Distribution Sydney area:** Sutherland to Mt Keira (Harden 1993).
**Select locations:** **CC:** Heathcote, Mt Keira.

### Habitat

**Habitat:**
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Open-forest e.g. with *Corymbia gummifera, Angophora costata, Eucalyptus sieberi;* heath e.g. with *Angophora hispida, Banksia serrata.*
**Substrate:** Sandy soils, sometimes with ironstone gravels, poorly-drained, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Local endemic species, coded 3RC- on national rare species list (Briggs & Leigh 1996). Reported in Royal NP, Heathcote NP but there is no information about abundance there; further investigation required to establish the range of the species (D. Keith pers. comm.).

## *Tricoryne elatior* ANTHERICACEAE (LILIACEAE)

### Life history

**Growth form:** Wiry herb 10–40 cm high, occasionally to 1 m high, with very narrow leaves, fibrous roots.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, October–March.
**Fruit/seed:** Dry fruit of 1–3 segments 3–6 mm long, with 1 black seed per segment. Mature January–February (Greening Australia 1996b). Viability of fresh seed 76% (Vigilante et al. 1998).
**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995). Soil-stored seedbank (Fox 1988). Smoking seed has no effect on germination (Greening Australia 1996c).
**Fire response:** Resprouts (Vigilante et al. (1998).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., S.A., W.A.
**Distribution Sydney area:** Widespread but mainly Western Sydney.
**Select locations:** CC: Putty, Morisset, Glenbrook, Pitt Town, Vineyard, Barrenjoey, Dee Why.

### Habitat

**Habitat:** Hillsides, slopes.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, E. tereticornis, E. crebra* and grassy understorey.
**Substrate:** Mainly clay, occasionally sandy soils on shale, Tertiary alluvium, medium nurients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Tricoryne simplex* ANTHERICACEAE (Liliaceae)

### Life history

**Growth form:** Herb to 30 cm high, with fibrous roots.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, August–December. Flowers open in the morning and close in the afternoon; probably pollinated by native bees and possibly also by flies (Diptera); one small butterfly briefly visited a flower (P. Kubiak pers. comm.).
**Fruit/seed:** Dry fruit of 1–3 segments 4 mm long, with 1 black seed per segment.
**Dispersal, establishment & growth:**
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove), fruiting within 11 months (P. Kubiak pers. comm.).
**Interaction with other organisms:** Some plants eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC.
**Distribution Sydney area:** Mainly coastal areas.
**Select locations:** CC: Morisset, Wisemans Ferry, Asquith, Hornsby, Cheltenham, Picton Lakes.

### Habitat

**Habitat:** Ridges.
**Altitude:** 0–300 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Angophora costata, Corymbia gummifera, Eucalyptus piperita.*
**Substrate:** Sandy soils from sandstone, sometimes with shale influence, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Aponogeton distachyos* * APONOGETONACEAE

Cape Pond Lily

### Life history

**Growth form:** Tuberous aquatic perennial herb.
**Vegetative spread:** Yes.
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, late winter.
**Fruit/seed:** Dry fruit 10 mm long, with 1–several seeds.
**Dispersal, establishment & growth:** Water dispersal (Carr et al. 1992).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC SWP; Vic., Tas., S.A.
**Distribution Sydney area:**
**Select locations:** CC: Rydalmere (1975).

### Habitat

**Habitat:** Creek.
**Altitude:** 0–100 m **Annual rainfall:** 1000–1200 mm
**Typical local abundance:** Rare.
**Vegetation:**
**Substrate:** Mud along stagnant creek.
**Exposure:**

### Conservation

**Conservation:** Only one record for Sydney area. Minor weed of small water bodies (Harden 1993).

## ***Alocasia brisbanensis*** (conf. *A. macrorrhizos*) **ARACEAE**

Cunjevoi, Spoon Lily

### Life history

**Growth form:** Large herb, erect to decumbent, 1–1.8 m high, with large trinangular-shaped leaves.
**Vegetative spread:** Subterranean bulbils (A. Hay pers. comm.).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Inflorescence functions as a 'flower' (A. Hay pers. comm.), mostly early summer.
**Fruit/seed:** Berry 8–15 mm long, red when ripe, with several seeds, April.
**Dispersal, establishment & growth:** Diaspore: seed, bird-dispersed (A. Hay pers. comm).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, W.A.
**Distribution Sydney area:** Coastal districts.
**Select locations:** CC: Botany, Albion Park, Kiama.

### Habitat

**Habitat:** Creekbanks.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:**
**Vegetation:** Rainforest.
**Substrate:** Alluvial soil, high nutrients.
**Exposure:**

### Conservation

**Conservation:** Illawarra is southern geographical limit, record from Botany was from old market garden in 1957.

## ***Arum italicum **** **ARACEAE**

Italian Arum

### Life history

**Growth form:** Deciduous perennial herb, with triangular-shaped leaves.
**Vegetative spread:** Local spread by rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Inflorescence functions as a 'flower' (A. Hay pers. comm.), early spring.
**Fruit/seed:** Berry 10 mm long, with several seeds.
**Dispersal, establishment & growth:** Diaspore: seed, bird-dispersed (A. Hay pers. comm.), rhizomes probably dispersed in garden refuse.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe. Widely cultivated as ornamental.
**Botanical subregions:** CC CT; Vic., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Kincumber (1950). CT: Orange (1978).

### Habitat

**Habitat:**
**Altitude:** 0–1000 m **Annual rainfall:** 800–1200 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Widely cultivated for the ornamental leaves and infructescences. Reported locally naturalised in the Wyong and Orange districts (Harden 1993), though these may be old garden remains.

## *Colocasia esculenta* * ARACEAE

Taro

### Life history

**Growth form:** Robust, tuberous, rhizomatous herb to 1 m high, with triangular-shaped leaves.
**Vegetative spread:** Stolons, about 100 cm long (EWAN).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Inflorescence functions as a 'flower' (A. Hay pers. comm.), summer.
**Fruit/seed:** Berry 3–5 mm long, with a distinctive odour (A. Hay pers. comm.), with many seeds. Seeds uncommon and of low viability (EWAN).
**Dispersal, establishment & growth:** Diaspore: seed (mammal-dispersed in Malesia, A. Hay pers. comm.), mainly vegetative dispersal by fragments of stolons and cormules (EWAN).
**Fire response:** Probably resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen, P. Kubiak pers. comm.).
**Interaction with other organisms:** Cultivated for more than 6000 years (EWAN), leaves and tubers eaten widely, but only after cleaning and cooking (Cribb & Cribb 1984), but not the feral forms (A. Hay pers. comm.). Allelopathic, can inhibit growth of other plants; contains calcium oxalate crystals, which can cause a mild sting or severe rash (EWAN).

### Distribution

**Status/origin:** Exotic, although native to Qld, N.T., W.A., Indomalesia to Japan and Pacific Is. Introduced as ornamental.
**Botanical subregions:** *NC *CC; *LHI, Qld, N.T., W.A.
**Distribution Sydney area:** Wyong area.
**Select locations:** CC: Wyong Creek (1950).

### Habitat

**Habitat:** Creeks, marshy places.
**Altitude:** 0–100 m **Annual rainfall:** 1200 mm
**Typical local abundance:** Frequent–dominant.
**Vegetation:**
**Substrate:** Organically rich soils, slightly acid, tolerates permanent inundation (EWAN).
**Exposure:** Full sun to dense shade (EWAN).

### Conservation

**Conservation:** Cultivated as ornamental and foodplant, only naturalised record is for Wyong Creek, cultivated at Point Clare. Capable of becoming a serious weed of wetlands, forming dense stands, displacing native plant species; physical removal of whole plant is the most effective control measure (EWAN).

## *Gymnostachys anceps* (*G. gigantea*) ARACEAE

Settlers Flax

### Life history

**Growth form:** Perennial herb with creeping rhizome, leaves erect, linear to 1.5 m long, inflorescence to 3 m high.
**Vegetative spread:** By creeping rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Bisexual, no spathe, inflorescence not integrated into a functional 'flower' (A. Hay pers. comm.), September–January.
**Fruit/seed:** Blue-black berry 10–15 mm long, with thin fleshy coat over single seed, mature July 97 (DHB).
**Dispersal, establishment & growth:** Diaspore: vertebrate-dispersed fleshy fruit (Westoby et al. 1990).
**Fire response:** Resprouted after high intensity fire 1994 (at Narrabeen), fruiting in 9 months (P. Kubiak pers. comm.).
**Interaction with other organisms:** Tested negative for alkaloids (Collins et al. 1990).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Qld.
**Distribution Sydney area:**
**Select locations:** **CC:** Wyong, Somersby, Mooney Mooney, West Head, Otford, Stanwell Park, Albion Park, Bulli Pass. **CT:** Mt Wilson, Bilpin, Robertson, Fitzroy Falls.

### Habitat

**Habitat:** Rainforest.
**Altitude:** 0–1000 m **Annual rainfall:** 1200–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Gully forest e.g. with *Livistona australis, Ceratopetalum apetalum*, and ground ferns e.g. *Pellaea falcata, Calochlaena dubia* (Gosford area), mixed warm temperate/cool temperate rainforest (Robertson area) e.g. with *Doryphora sassafras.*
**Substrate:** Clay soils on basalt, Narabeen shales, high nutrients, well-drained.
**Exposure:** Medium shade.

### Conservation

**Conservation:** Conservation status unknown, though many rainforest sites affected by weed invasion. Reported in Bouddi NP, Brisbane Water NP, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Royal NP, Robertson NR.

## *Pistia stratiotes* * ARACEAE

Water Lettuce

### Life history

**Growth form:** Free-floating, perennial aquatic herb, with stolons to 60 cm long (Parsons & Cuthbertson 1992).
**Vegetative spread:** Stoloniferous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** At any time of year.
**Fruit/seed:** Greenish berry 6–10 mm long. Seed 2 mm long, 4–15 per fruit, with wrinkled seedcoat, oblong, flattened at apex and containing an air chamber (Parsons & Cuthbertson 1992).
**Dispersal, establishment & growth:** Diaspore: seed, water-dispersed; vegetative dispersal of daughter plants that form on stolons and through aquarium trade (Parsons & Cuthbertson 1992).
**Fire response:**
**Interaction with other organisms:** Provides shelter and breeding site for disease-carrying mosquitoes *Anopheles* species and *Mansonia* species, whose larvae obtain oxygen directly from the roots so do not need to surface to breathe (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to northern Australia and pantropic regions.
**Botanical subregions:** NC CC; Qld, N.T. native to northern Australia & pantropical regions.
**Distribution Sydney area:** Centennial Park.
**Select locations:** **CC:** Centennial Park (1974).

### Habitat

**Habitat:** Lakes, water bodies.
**Altitude:** 0–100 m **Annual rainfall:** 1200 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Open still or slowly-moving water.
**Exposure:**

### Conservation

**Conservation:** Declared noxious weed in NSW, though only Sydney area record is for Centennial Park in 1974.

## *Typhonium brownii* ARACEAE

### Life history

**Growth form:** Perennial herb.
**Vegetative spread:** Proliferation from cormils (A. Hay pers. comm.).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** April. Inflorescence functions as a 'flower' (A. Hay pers. comm.). Pollinated by dung beetles (Monteith 1986),
**Fruit/seed:** Reddish berry 10 mm diam., with one seed.
**Dispersal, establishment & growth:** Diaspore: seed, and vegetatively by cormils (A. Hay pers. comm.).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CT CWS; Qld.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Culoul Range, Windsor, Nepean River, Menangle. **CT:** Capertee Valley (1913).

### Habitat

**Habitat:** Sheltered gullies, along creek banks.
**Altitude:** 0–720 m **Annual rainfall:** 700–900 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Moist open-forest e.g. with *Syncarpia glomulifera, Eucalyptus saligna;* rainforest margins.
**Substrate:** Clay soil on basalt, high nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Typhonium eliosurum* ARACEAE

### Life history

**Growth form:** Perennial herb, facultatively deciduous (A. Hay pers. comm.), to 50 cm high, with 3-lobed leaves, with tuberous rhizome.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Inflorescence functions as a 'flower' (A. Hay pers. comm.), late spring–early summer.
**Fruit/seed:** Reddish berry 10 mm diam., with one seed.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC.
**Distribution Sydney area:** Coastal, Wyong to Nowra.
**Select locations:** **CC:** Patonga, Royal NP, Stanwell Park, Calderwood Park, Shellharbour, Cambewarra, Mt Coolangatta.

### Habitat

**Habitat:** Moist locations, often rainforest (Mills 1988).
**Altitude:** 0–300 m **Annual rainfall:** 1200–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Rainforest margins e.g. with *Cassine australis, Acmena smithii, Banksia integrifolia.*
**Substrate:** Clay loam on shale, basalt, alluvium, medium to high nutrients.
**Exposure:**

### Conservation

**Conservation:** Coded 3RC- on national rare species list (Briggs & Leigh 1996). Reported in Royal NP.

## *Zantedeschia aethiopica* * ARACEAE

Arum Lily, Pig Lily

### Life history

**Growth form:** Robust clump-forming perennial herb, with triangular-shaped leaves, with rhizome. Top growth dies back over summer (EWAN).
**Vegetative spread:** Rhizomatous, less than 300 mm per year (EWAN).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White, small, within a large showy, funnel-shaped bract (Parsons & Cuthbertson 1992), mostly spring.
**Fruit/seed:** Orange fleshy fruit 10 mm long, with a few seeds. Seeds yellow-brown, 3 mm diam. (Parsons & Cuthbertson 1992). Large amounts of seed produced; seed viability 4 months (EWAN).
**Dispersal, establishment & growth:** Diaspore: Birds attracted to succulent berries disperse seed, also spread by foxes, stock and flowing water; rhizomes dispersed by dumping of garden waste (EWAN). Seed, germinates in late autumn to winter, best with fluctuating temperatures 15°C and 20°C; growth is slow at first as fleshy rootstock and rhizomes develop (Parsons & Cuthbertson 1992).
**Fire response:**
**Interaction with other organisms:** All parts of the plant are toxic, with reported fatalities of cattle and children (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to S and SE Africa. Introduced as ornamental.
**Botanical subregions:** CC SC; Vic., Tas., S.A., WA.
**Distribution Sydney area:** Sporadic, coastal.
**Select locations:** CC: Lisarow (1975), Devlins Creek (1957), Port Hacking (1953), Upper Kangaroo Valley (1973).

### Habitat

**Habitat:** Swampy creeks, riverbanks.
**Altitude:** 0–400 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Estuarine swamps e.g. with *Melaleuca linariifolia, Eucalyptus robusta.*
**Substrate:** Clay soil on alluvium, medium nutrients.
**Exposure:** Mid shade.

### Conservation

**Conservation:** Commonly cultivated, persisting around habitations or occasionally naturalised in open or semi-shaded marshy places south from Gosford (Harden 1993).

## *Archontophoenix cunninghamiana* ARECACEAE

Bangalow Palm

### Life history

**Growth form:** Tree to 25 m high, with pinnately divided leaves.
**Vegetative spread:** No.
**Longevity:** Up to 100 years, juvenile growth to 4 m high trunk in 15 years (DBH, in cultivation).
**Primary juvenile period:** 5–8 years (in cultivation).
**Flowers:** Pink to lilac, male and female flowers separate on same plant, autumn.
**Fruit/seed:** Red fleshy fruit 13–15 mm diam., waxy, single seed 8–10 mm diam. covered with fibres, December–May, (Floyd 1989).
**Dispersal, establishment & growth:** Diaspore: seed, gravity-dispersed, bird-dispersed. No dormancy, short-lived seeds viable for 8–16 weeks (Langkamp 1987).
**Fire response:** Probably killed.
**Interaction with other organisms:** Flowers eaten by Rainbow Lorikeet *Trichoglossus haematodus* (Lepschi 1993). Fruit eaten by Brown Cuckoo-Dove, Crimson Rosella, Green Catbird, Lewin's Honeyeater, Pied Currawong, Rose-crowned Fruit Dove, Satin Bowerbird, Topknot Pidgeon, Wompoo Fruit-Dove, White-headed Pigeon (Floyd 1989). Fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995). Food plant of butterfly larvae *Telicota ancilla ancilla* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld.
**Distribution Sydney area:** Coast and coastal ranges.
**Select locations:** CC: Ourimbah, Matcham, Illawarra.

### Habitat

**Habitat:** Creekbanks, alluvial flats.
**Altitude:** 0–300 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Gully rainforest e.g. with *Ceratopetalum apetalum, Glochidion ferdinandi, Smilax australis, Cissus hypoglauca, Ripogonum fawcettianum.*
**Substrate:** Clay soils on shales, basalt, alluvium, high–medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Cultivated as ornamental, conservation status unknown.

## *Livistona australis* ARECACEAE

Cabbage Palm, Cabbage Tree Palm, Fan Palm

### Life history

**Growth form:** Tree to 30 m high; palmately divided leaves with spines.
**Vegetative spread:** No.
**Longevity:** 100–200 years (at least 155 years, juvenile growth to 0.5 m high trunk in 15–20 years (DBH, in cultivation), mature growth estimated at 1 m in 6 years (Orscheg & Parsons 1996).
**Primary juvenile period:** Greater than 20 years.
**Flowers:** Cream–yellow, summer. Time between successive flowering may be more than 2 years (Orscheg & Parsons 1996).
**Fruit/seed:** Fleshy fruit, red turning black, with one seed. Interval between flowering and fruit fall may be 18 months; mature March–April (Orscheg & Parsons 1996).

**Dispersal, establishment & growth:** Diaspore: short-lived seeds 4–16 weeks (Langkamp 1987). Dispersal: gravity-dispersed, bird-dispersed. Most dispersal by gravity (Orscheg & Parsons 1996). Seed germinates in 1–3 months (Floyd 1989), seed age strongly affects viability, seed to 2 months old gave 7–11% germination at 20–25°C, seed 16 months old gave 5% germination; seed shed in autumn may not germinate until higher temperatures in spring; once food reserves in seeds are exhausted, seedlings may be out-competed by e.g. *Calochlaena dubia* (Orscheg & Parsons 1996).

**Fire response:** Resprouts, leaves continue to grow on adult plants after fire (LMcD). 1–2 leaf seedlings killed but most seedlings and juveniles at the 4-leaf stage (2–3 years old) or older survived by resprouting after wildfire (at Royal NP, 1994) (Orscheg & Parsons 1996).
**Interaction with other organisms:** Fruit eaten by Pied Currawong, Topknot Pigeon, White-headed Pigeon (Floyd 1989). Blossoms and fruit eaten by Grey-headed Flying Fox *Pteropus poliocephalus* (Eby 1995). Food plant of butterfly larvae *Telicota ancilla ancilla* (Common & Waterhouse 1981). Possible

predation of seedlings by Bush Rat *Rattus fuscipes* and fruit by Bush Rat or Common Brush-tailed Possum *Trichosurus vulpecula* (Orscheg & Parsons 1996).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic.
**Distribution Sydney area:** Widespread in coastal areas.
**Select locations:** **CC:** Mooney Mooney, Pearl Beach, Bayview, Port Jackson, Kurnell, Bola Creek, Garie Beach, Grose River, Mt Cambewarra, Upper Kangaroo Valley.

### Habitat

**Habitat:** Creeks, swampy places.
**Altitude:** 0–200 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Moist sclerophyll forest e.g. with *Eucalyptus saligna, E. pilularis, Syncarpia glomulifera;* rainforest margins.
**Substrate:** Clay soils on shales, alluvium, medium nutrients, sometimes poorly-drained.
**Exposure:** Full sun to light shade.

### Conservation

**Conservation:** Common on the southern foreshores of Sydney Harbour in 1788 and used by the settlers for building huts. Conservation status unknown. Reported in Bouddi NP, Brisbane Water NP, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Sydney Harbour NP.

## *Asparagus aethiopicus** ASPARAGACEAE (LILIACEAE)

*(Protasparagus aethiopicus, P. densiflorus, Asparagus densiflorus)*

Asparagus Fern, Sprengeri Fern

### Life history

**Growth form:** Perennial herb with spiny, sprawling stems to 2 m long; leaves bract-like scales, cladodes narrow to 2.5 cm long; fibrous and tuberous roots (tubers are not reproductive).
**Vegetative spread:** Forms thick mat of rhizomes.
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to pinkish, spring–autumn (J. Hosking pers. comm.). Probably pollinated by Honeybees *Apis mellifera* and possibly native bees (P. Kubiak pers. comm.).
**Fruit/seed:** Red berry, late winter–early spring.
**Dispersal, establishment & growth:** Diaspore: fruit, bird-dispersed, with large amount of seed seen at the base of trees. Seed viable for 5 years in soil (M. Clarke pers. comm.).
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove), fruiting in 1 year (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** NC CC SC ?SWS; LHI, Qld, S.A., W.A.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Patonga, Commodore Heights (1951), Northbridge (1953), Beecroft, Manly, Balmoral, Boronia Park, Bellevue Hill (1954), Oatley.

### Habitat

**Habitat:** Rock crevices, stream banks, sand dunes.
**Altitude:** 0–200 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Coastal heath e.g. with *Westringia fruticosa;* scrub e.g. with *Pittosporum undulatum;* coastal sand dunes to open-woodland e.g. with *Angophora costata, Corymbia gummifera.*
**Substrate:** Sandy or skeletal soils, mainly on Hawkesbury Sandstone, low–medium nutrients, well-drained fertile soils (M. Clarke pers. comm.).
**Exposure:** Light to medium shade.

### Conservation

**Conservation:** Cultivated as ornamental. Extensively naturalised along the coast, and a serious weed in bushland (Harden 1993). Appears to be particularly establishing on harbour and estuary foreshores. Control by removal of fruit and rhizomes; where extensive mats have formed, use a mattock to loosen the rhizomatous mat, rolling up like a carpet.

## ***Asparagus asparagoides*** * *(Myrsiphyllum asparagoides)* **ASPARAGACEAE** (LILIACEAE)

Florist's Smilax

### Life history

**Growth form:** Climbing herb with stems to 3 m long, with rhizome and clustered masses of tuberous roots; leaves scale-like, leaf-like cladodes to 4 cm long.
**Vegetative spread:** By rhizomes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White, July–September.
**Fruit/seed:** Red berry 5–19 mm diam., with 1–many seeds. Fruits mostly ripen in spring (J. Hosking pers. comm.). Mature fruit can remain on plant for several months, (M. Clarke pers. comm.). Seeds germinate readily at temperatures between 10°–20°C (NRE 1999).
**Dispersal, establishment & growth:** Diaspore: fruit, bird-dispersed (M. Clarke pers. comm.). Seed spread in mud adhering to animals and machinery; vehicles can spread seeds and roots (NRE 1999). Seeds probably viable for 4–5 years in soil, germinates easily; stems die back in hot dry periods (M. Clarke pers. comm.).
**Fire response:** Resprouts rapidly after wildfire (NRE 1999), fruiting in less than 1 year (P. Kubiak pers. comm.).
**Interaction with other organisms:** A cicadellid leafhopper *Zygina* sp. that sucks cell content from cladodes and a rust fungus *Puccinia myrsiphylla* have been released for biological control (J. Hosking pers. comm.).

### Distribution

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** NC CC SC NWS CWS SWS SWP; LHI, Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Mainly western Sydney.
**Select locations:** **CC:** North Richmond, Pymble, Cheltenham (1949), Lugarno (1953), Liverpool, Nepean River Cobbitty (1951), Douglas Park.

### Habitat

**Habitat:** River banks.
**Altitude:** 0–400 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Riverflat forest e.g. with *Casuarina glauca, Casuarina cunninghamiana;* Cumberland Plain Woodland e.g. with *Eucalyptus moluccana, E. tereticornis.*
**Substrate:** Clay soils on shale, alluvium, mediium nutrients, well-drained.
**Exposure:** Full sun to light shade.

### Conservation

**Conservation:** Serious bushland weed particularly in western Sydney. Canopy smothers other vegetaton, and masses of underground rhizomes and tubers form thick mats. Control by removal of fruit and rhizomes (M. Clarke pers. comm.).

## ***Asparagus officinalis*** * **ASPARAGACEAE** (LILIACEAE)

Asparagus

### Life history

**Growth form:** Erect, perennial herb 0.5–1.5 m high, with scale-like leaves and narrow cladodes to 2.5 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Greenish white, spring–summer.
**Fruit/seed:** Red berry with 3–6 shiny black seeds, until June.
**Dispersal, establishment & growth:** Diaspore: berry. Bird and possibly animal-dispersed (Carr et al. 1992).
**Fire response:** Probably resprouted after high intensity fire 1994 (at Lane Cove), fruiting within 5 months (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe, N Africa and W Asia. Introduced as food plant.
**Botanical subregions:** CC CT NWS CWS NWP SWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Suburban areas.
**Select locations:** **CC:** Mangrove Mountain (1995), Woy Woy (1922), Cheltenham (1946), Gordon (1914), Casula (1964). **CT:** Bathurst (1987).

### Habitat

**Habitat:** Roadsides and weedy areas.
**Altitude:** 0–800 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Weedy areas.
**Substrate:** Clay soil.
**Exposure:**

### Conservation

**Conservation:** Commonly cultivated for its edible stems. Occasionally naturalised near cultivation.

## *Asparagus plumosus* * *(Protasparagus plumosus)* ASPARAGACEAE (Liliaceae)

Climbing Asparagus Fern

### Life history

**Growth form:** Vine with wiry climbing stems to c. 5 m long and spines; leaves bract-like scales, cladodes to 7 mm long.
**Vegetative spread:** New shoots form along rhizomes in spring (Parsons & Cuthbertson 1992).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Greenish to white, February–June.
**Fruit/seed:** Black berry 5 mm diam., summer until June. Fruiting material collected 1/10/02 (J. Hosking pers. comm.).
**Dispersal, establishment & growth:** Diaspore: fruit, bird-dispersed. Also probably dispersed by bats (J. Hosking pers. comm.).
**Fire response:**
**Interaction with other organisms:** Foodplant of Silvereye *Zosterops lateralis* (Barker & Vestjens 1989,1990).

### Distribution

**Status/origin:** Exotic, native to southern Africa. Introduced as ornamental.
**Botanical subregions:** NC CC ?SWS; LHI, Qld, Vic., S.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Mackeral Beach (1997), Epping (1950), Jibbon Beach (1963).

### Habitat

**Habitat:** Coastal estuaries, foreshores.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:**
**Vegetation:** Swamp forest e.g. with *Casuarina glauca;* open-forest e.g. with *Eucalyptus pilularis.*
**Substrate:** Sandy soil on dune sand, clay soil on shale, low–medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Cultivated as ornamental. Occasionally naturalised in Sydney area but more extensive on North Coast.

## *Asparagus scandens* (*Myrsiphyllum scandens*) ASPARAGACEAE (LILIACEAE)

Asparagus Fern

### Life history

**Growth form:** Climber with scrambling stems to about 2 m long, with scale-like leaves and narrow leaf-like cladodes to 1.5 cm long.
**Vegetative spread:** Tubers can form mats (EWAN).
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to pinkish, winter–early spring.
**Fruit/seed:** Red berry 5–7 mm diam., with one black shiny seed, mature until summer.
**Dispersal, establishment & growth:** Diaspore: fruit, bird-dispersed. Vegetative spread from tubers in garden waste (EWAN).
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa; introduced as ornamental.
**Botanical subregions:** CC; Vic.
**Distribution Sydney area:** Sydney suburbs.
**Select locations:** CC: Greys Point (1998), Wahroonga (1973), Lindfield (1982), Cheltenham (1979), Ashton Park Mosman (1965).

### Habitat

**Habitat:** Moist gullies.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 m
**Typical local abundance:** Frequent.
**Vegetation:** Open forest e.g. with *Eucalyptus saligna, E. pilularis.*
**Substrate:** Clay soil on shale, medium nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Cultivated as ornamental. Occasionally naturalised in urban bushland since 1970. Potential spread unknown.

## *Asparagus virgatus* (*Protasparagus virgatus*) ASPARAGACEAE (LILIACEAE)

Asparagus Fern

### Life history

**Growth form:** Erect herb or shrub 0.4–0.8 m high, with scale-like leaves, no spines.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Greenish white, spring–summer.
**Fruit/seed:** Orange berry 4-6 mm diam, with one seed, at any time of year.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** CC; Qld.
**Distribution Sydney area:**
**Select locations:** CC: Colyton (1984).

### Habitat

**Habitat:**
**Altitude:** 0–200 m **Annual rainfall:** 800 mm
**Typical local abundance:**
**Vegetation:** Weedy area.
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Cultivated as ornamental. Rarely recorded naturalised, only record is Colyton.

## *Asphodelus fistulosus* * **ASPHODELACEAE** (LILIACEAE)

Onion-weed, Asphodel, Wild Onion

### Life history

**Growth form:** Erect herb with flowering stem 20–80 cm high. Root long and fibrous, yellow, no taproot (Parsons & Cuthbertson 1992).

**Vegetative spread:**

**Longevity:** Annual or biennial or short-lived perennial (Parsons & Cuthbertson 1992).

**Primary juvenile period:**

**Flowers:** White or pale pink with red-brown stripe, August–November.

**Fruit/seed:** Brown capsule 4–6 mm diam., with 1–2 brown or black wrinkled seeds 3–4 mm long (Parsons & Cuthbertson 1992).

**Dispersal, establishment & growth:** Diaspore: seed. Animal, water and wind-dispersed (Carr et al. 1992), dispersed on vehicles, machinery, animals, wool, clothing; germination at any time of year but mainly late summer and autumn; establishes most easily in disturbed areas (Parsons & Cuthbertson 1992).

**Fire response:**

**Interaction with other organisms:** Not eaten by stock; the fungus *Fusarium* destroys the roots; fungus *Puccinia barbeyi* may be a possible control agent (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to Native of S Europe east to India.

**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., S.A., N.T., W.A.

**Distribution Sydney area:** Sporadic.

**Select locations:** CC: Richmond (1987), Milson Island (1912), Shellharbour (1949). CT: Bathurst (1939).

### Habitat

**Habitat:** Cemeteries, gardens.

**Altitude:** 0–800 m **Annual rainfall:** 600–1400 mm

**Typical local abundance:** Frequent.

**Vegetation:**

**Substrate:** Particularly common on limestone (J. Hosking pers. comm.). Grows well on sandy alkaline soils; able to withstand drought (Parsons & Cuthbertson 1992).

**Exposure:** Full sun.

### Conservation

**Conservation:** Declared noxious weed in some shires of NSW (Harden 1993). Control by cultivation or hand removal (Parsons & Cuthbertson 1992).

## ***Bulbine bulbosa*** *(Bulbinopsis bulbosa)* **ASPHODELACEAE** (LILIACEAE)

Native Leek, Bulbine Lily, Golden Lily

### Life history

**Growth form:** Perennial herb to 75 cm high, with thick roots, often with a bulb.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, with brown stripe, fragrant, September–January, peak October.
**Fruit/seed:** Capsule 3–6 mm long; seeds brown to almost black 0.8–2 mm long. Mature December–January (Greening Australia 1996b).
**Dispersal, establishment & growth:** Diaspore: seed, germination after storage 2–3 months takes approx. 35 days, with about 165 seedlings per gram seed; high temperatures inhibit germination (Greening Australia 1996b).
**Fire response:**
**Interaction with other organisms:** Palatable to rabbits (Leigh et al. 1987). Suspected of causing illness and death in cattle, horses and sheep (Harden 1993). Bulb reported eaten by Aboriginal people (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., W.A.
**Distribution Sydney area:** Cumberland Plain, Bathurst–Orange area.
**Select locations:** **CC:** Bilpin, Scheyville, Marayong, St Marys. **CT:** Rylstone, Sunny Corner, Oberon, Jenolan Caves, Wombeyan Caves.

### Habitat

**Habitat:** Damp places.
**Altitude:** 0–1000 m **Annual rainfall:** 700–900 mm
**Typical local abundance:** Frequent.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, E. crebra, E. macrorrhyncha, Bursaria spinosa;* grassland.
**Substrate:** Clay soils on Wianamatta Shale, basalt, conglomerate, low–high nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation elsewhere unknown.

## ***Bulbine glauca*** *(B. semibarbata)* **ASPHODELACEAE** (LILIACEAE)

Bulbine Lily, Rock Lily

### Life history

**Growth form:** Perennial tufted herb to 110 cm high, with thick roots, sometimes with a short rhizome.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, with red-brown stripe, October–December.
**Fruit/seed:** Capsule 3–6 mm long, with seeds to 3 mm long. Mature December–January (Greening Australia 1996b).
**Dispersal, establishment & growth:** Diaspore: seed, germination after storage 2–3 months takes approx. 35 days, with about 165 seedlings per gram of seed; high temperatures inhibit germination (Greening Australia 1996b).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** SC ?NT ?CT ST; Vic.
**Distribution Sydney area:** Orange area.
**Select locations:** **CT:** Junction Reefs, Belubula River (1991).

### Habitat

**Habitat:** In crevices on cliffs.
**Altitude:** 550 m **Annual rainfall:** 800 mm
**Typical local abundance:** Frequent.
**Vegetation:**
**Substrate:** Cliffs of slaty metamorphic rocks near river.
**Exposure:**

### Conservation

**Conservation:** Rare, only Sydney area record is from Belubula River.

## ***Bulbine semibarbata*** *(Bulbinopsis semibarbata)* **ASPHODELACEAE** (LILIACEAE)

Native Leek, Wild Onion, Leek Lily

### Life history

**Growth form:** Herb to 50 cm high, with fibrous roots.
**Vegetative spread:**
**Longevity:** Usually less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** Yellow, with red-brown stripe, July–January.
**Fruit/seed:** Capsule 2–5 mm long, with seeds 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Kiama (1899) Wallerawang (1917).

### Habitat

**Habitat:**
**Altitude:** 0–1000 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Rare, no recent records.

## *Kniphofia uvaria* * (*Kniphofia aloides*) **ASPHODELACEAE** (LILIACEAE)

Red Hot Poker

**Life history**

**Growth form:** Perennial herb, with basal leaves and thick rhizome; flowering parts to 1.5 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Orange-red to yellow-green, February.
**Fruit/seed:** Capsule 7–14 mm diam.,
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** CT ST.
**Distribution Sydney area:**
**Select locations:** CT: Wentworth Falls (1992).

**Habitat**

**Habitat:** Swampy sites.
**Altitude:** 1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Sedge swamp.
**Substrate:** Peaty moist soil over sandstone, poorly-drained, low nutrients.
**Exposure:**

**Conservation**

**Conservation:** Widely cultivated as ornamental. Occasionally naturalised or persisting near old habitations in Upper Blue Mountains.

## *Trachyandra divaricata* * **ASPHODELACEAE** (LILIACEAE)

Strapweed

**Life history**

**Growth form:** Erect, tufted perennial herb to 70 cm high, with vertical rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, with a brown central stripe and gold toward the base, July–January.
**Fruit/seed:** Brown–black capsule 3–10 mm long, with 3–22 (average 11) red-brown to black seeds 1–2 mm long. About 200 fruits per plant with about 2000 seeds (Heyligers 1999).
**Dispersal, establishment & growth:** Diaspore: 'crown' of tangled, fruiting, hollow stems, wind-dispersed ('tumbleweed') and buoyant in seawater, may stay afloat for several weeks, but small seeds, once released, may sink within minutes, viable for up to 8 months in seawater (Heyligers 1999).
**Fire response:**
**Interaction with other organisms:** Plants are toxic to animals, particularly horses (J. Hosking pers. comm.).

**Distribution**

**Status/origin:** Exotic, native to S Africa. Possibly introduced from Western Australia as contaminant of *Acacia saligna* seed in planting stock used in dune restoration work (Heyligers 1999).
**Botanical subregions:** NC CC; S.A., W.A.
**Distribution Sydney area:** Coast, Port Stephens to Kiama.
**Select locations:** CC: Wamberal Beach (1985), Maroubra (1975), Killalea Beach (1996), Fairy Meadow (1968).

### Habitat

**Habitat:** Sand dunes, particularly rehabilitated dune areas.
**Altitude:** 0–20 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassland e.g. with *Spinifex hirsutus.*
**Substrate:** Beach sand dunes.
**Exposure:** Full sun.

### Conservation

**Conservation:** First recorded in 1968 near Wollongong. Naturalised on coastal sand dunes from Port Stephens to Wollongong area (Harden 1993), with potential to spread further (Heyligers 1999).

## *Cordyline stricta* ASTELIACEAE (AGAVACEAE)

Narrow-leaved Palm Lily

### Life history

**Growth form:** Shrub to 5 m high, sometimes sprawling and branched towards the base, with narrow leaves.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Bluish, November.
**Fruit/seed:** Purple to black berry 10–15 mm long, with black seeds, March–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT; Qld.
**Distribution Sydney area:** Lower Blue Mountains.
**Select locations:** CC: Wheeny Creek, Mountain Lagoon, Bilpin.

### Habitat

**Habitat:** Gullies, steep hillsides.
**Altitude:** 0–300 m **Annual rainfall:** 1000–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Rainforest.
**Substrate:** Clay soil on basalt, high nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Bilpin is southern geographical limit.

## *Blandfordia cunninghamii* BLANDFORDIACEAE (LILIACEAE)

### Life history

**Growth form:** Tufted perennial herb, with leaves to 100 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Bell-shaped, red with yellow lobes, November–March, peak January, through few plants flowering in some seasons (Porter 1992).
**Fruit/seed:** Capsule to 9 cm long, with numerous hairy seeds, January.
**Dispersal, establishment & growth:** Diaspore: seed
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC CT.
**Distribution Sydney area:** Blue Mountains, Illawarra.
**Select locations:** CC: Wedderburn (Keith 1994), Mt Kembla, Bargo River. CT: Mt Tomah, Mt Wilson, Blackheath, Leura, Wentworth Falls.

### Habitat

**Habitat:** Sandstone cliff edges.
**Altitude:** 200–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Moist cliff edges e.g. with *Gleichenia, Blechnum, Gahnia, Daviesia mimosoides.* Moist habitats, particularly damp rock faces e.g. with *Acacia elata, Callicoma serratifolia, Leptospermum polygalifolium, Stylidium productum, Dianella caerulea, Epacris pulchella, Gonocarpus teucrioides, Styphelia triflora* (Porters 1992).
**Substrate:** Shallow peaty soils over sandstone, low nutrients, poorly-drained. Higher proportion of silt and clay at sites where *B. cunninghamii* occurs (Porters 1992).
**Exposure:**

### Conservation

**Conservation:** Restricted local endemic, coded 3RCi on national rare species list (Briggs & Leigh 1996). Population sizes range from 1–300 plants (Porter 1992). Reported in Blue Mountains NP.

## *Blandfordia grandiflora* BLANDFORDIACEAE (LILIACEAE)

### Life history

**Growth form:** Tufted perennial herb, with leaves to 70 cm long. Other forms, possibly hybrids approaching *B. nobilis* sometimes found in southern parts of its range (Harden 1993). Distinction between *B. grandiflora* and *B. cunninghamii* is based on vegetative rather than floral attributes and is made difficult by phenotypic response of *B. cunninghamii* plants to light intensity (Porter et al. 1992).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Red with yellow tips, November–February, peak December. Flowers visited by honey eaters which favoured plants with most flowers; these plants achieve higher amounts of self-pollination and cross-pollination (Paton 1982).
**Fruit/seed:** Capsule 6 cm long, with numerous hairy seeds, December.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CT; Qld.
**Distribution Sydney area:** Coast and Tablelands.
**Select locations:** CC: Mangrove Mountain, Wyong, Somersby, Calga, Mt White, Bilpin, Woodford. CT: Lawson.

### Habitat

**Habitat:** Rock shelves, slopes, ridges.
**Altitude:** 0–900 m **Annual rainfall:** 1100–1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** Open-forest and woodland.
**Substrate:** Damp sandy or peaty soils over sandstone, low nutrients, poorly drained.
**Exposure:**

### Conservation

**Conservation:** Lawson is southern geographical limit. Conservation status unknown.

## *Blandfordia nobilis* BLANDFORDIACEAE (LILIACEAE)

### Life history

**Growth form:** Erect perennial herb. Woody underground bulb 2 cm long with ?contractile roots. Moderately variable with extremes approaching *B. grandiflora* in the northern parts of its range, suggesting that the species may hybridize (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:** Plants take 5 years to flower and then flower sporadically (Lyn Parry, newspaper cutting).
**Flowers:** Red with yellow lobes, September–February, peak December–January.
**Fruit/seed:**
**Dispersal, establishment & growth:** Diaspore: seed, no special morphology for dispersal (Westoby et al. 1990).
**Fire response:** Foliage killed. Resprouts, plants often respond by flowering and seeding 1 year after fire (D. Keith pers. comm.), apparently increased flowering after high intensity fire 1994 (P. Kubiak pers. comm.).
**Interaction with other organisms:** Leaves frequently eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC CT ST.
**Distribution Sydney area:** Mainly coast.
**Select locations: CC:** Mt White, Gosford, Springwood, Mt Colah, Pennant Hills, Belrose, Beacon Hill, Kurnell, Arncliffe (1886), Como, Kentlyn, Kiama, Barren Grounds. **CT:** Robertson, Carrington Falls.

### Habitat

**Habitat:** Damp places, swamps.
**Altitude:** 0–600 m **Annual rainfall:** 1200–1800 mm
**Typical local abundance:** Frequent.
**Vegetation:** Wet heath, sedgeland e.g. with *Schoenus brevifolius, Drosera.*
**Substrate:** Shallow sandy soil on sandstone, low nutrients, moist.
**Exposure:** Full sun.

### Conservation

**Conservation:** Conservation status unknown. Reported in Ku-ring-gai Chase NP, Garigal NP.

## *Burmannia disticha* BURMANNIACEAE

### Life history

**Growth form:** Erect herb to 70 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Tubular, blue with yellow bands, at any time of year.
**Fruit/seed:** Capsule 6–20 mm long, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT; Qld, Asia.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Gosford (1927).

### Habitat

**Habitat:** Swamps, wetlands.
**Altitude:** 0–50 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:** Shady sites.

### Conservation

**Conservation:** Rare, Gosford is southern geographical limit, last recorded 1927.

## *Canna indica* * CANNACEAE

Canna

### Life history

**Growth form:** Erect, glabrous herb to 2 m high, with rhizomes.
**Vegetative spread:** Locally by rhizomes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Red to yellow, spring–summer.
**Fruit/seed:** Hard capsule 2–3 cm long, with black seeds.
**Dispersal, establishment & growth:** Dispersed in garden waste.
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), flowering in 38 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America. Introduced as ornamental.
**Botanical subregions:** NC CC SC CT; Qld.
**Distribution Sydney area:**
**Select locations:** CC: Matcham (1991), Manly Vale (1982), Woolooware Bay (1976), Campbelltown (1967), Macquarie Pass (1951), Barren Grounds (1954).

### Habitat

**Habitat:** Disturbed areas, creeks, near habitation.
**Altitude:** 0–200 m **Annual rainfall:** 200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Wetlands e.g. with *Typha;* edge of *Ceratopetalum apetalum, Casuarina glauca* swamp; gully rainforest e.g. with *Glochidion ferdinandi, Archontophoenix cunninghamiana, Smilax australis.*
**Substrate:** Sandy soils on alluvium, clay soils on shale, low–medium nutrients, poorly-drained.
**Exposure:**

### Conservation

**Conservation:** Often cultivated as ornamental; naturalised in disturbed land and along creeks, mostly near habitation, north from Macquarie Pass.

## *Centrolepis fascicularis* CENTROLEPIDACEAE

### Life history

**Growth form:** Perennial herb forming dense cushions 3–20 cm diam.
**Vegetative spread:**
**Longevity:** Perennial.
**Primary juvenile period:**
**Flowers:** November–February.
**Fruit/seed:** Dehiscent, 1-seeded follicle. Seed germinates without treatment (G. Knox pers. comm.).
**Dispersal, establishment & growth:** Diaspore: seed.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST; Qld, Vic., Tas., S.A., ?*W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Howes Valley, Killcare, Manly, Leumeah, Botany (1888), La Perouse, Kurnell, Lodden Falls. **CT:** Ilford, Blackheath, Wentworth Falls, Barrengarry Mountain, Hanging Rock Swamp, Penrose.

### Habitat

**Habitat:** Heathland, bogs, wet rocky riverbanks.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Wet heath e.g. with *Gleichenia, Sphagnum, Blechnum nudum, Empodisma, Drosera;* margins of hanging swamp; woodland e.g. with *Eucalyptus piperita, Gleichenia microphylla.*
**Substrate:** Moist, peaty soil over sandstone, permanently moist, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Centrolepis strigosa* subsp. *strigosa* CENTROLEPIDACEAE

### Life history

**Growth form:** Tufted herb to 10 cm high.
**Vegetative spread:** No.
**Longevity:** Short-lived annual (G. Knox pers. comm.).
**Primary juvenile period:** 11 months (P. Kubiak pers. comm.).
**Flowers:** September–December.
**Fruit/seed:** Dehiscent, 1-seeded follicle. Seed germinates without treatment (G. Knox pers. comm.).
**Dispersal, establishment & growth:**
**Fire response:** Probably killed after high intensity fire 1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Agnes Banks, Cheltenham, Gladsville, Rose Bay (1901), Malabar, Kurnell, Leumeah, Bomaderry. **CT:** Bathurst, Little Hartley, Yerranderie, Mittagong, Marulan.

### Habitat

**Habitat:** Creekbanks, rock ledges, pavements.
**Altitude:** 0–700 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus paramattensis, Angophora bakeri;* moist scrub e.g. with *Kunzea ambigua, Melaleuca nodosa;* often associated with moss beds, sedgeland.
**Substrate:** Shallow sandy soil on sandstone, dune sand, Tertiary alluvium, granite, periodically moist, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999).

## *Burchardia umbellata* COLCHICACEAE (LILIACEAE)

Milkmaids

**Life history**

**Growth form:** Perennial herb, with tuberous roots, one or two basal leaves and narrow leaves to 60 cm long; flower stalk 10–65 cm high.

**Vegetative spread:**

**Longevity:**

**Primary juvenile period:**

**Flowers:** White, occasionally tinged with pink. Flowers visited by more than one species of fly (Diptera) and tiny beetles (Coleoptera) (P. Kubiak pers. comm.).

**Fruit/seed:** Capsule 10–15 cm long, with brown seeds. Mature December–January (Greening Australia 1996b). Viability of fresh seed 93%, after 1 year storage 28% (Vigilante et al. (1998).

**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.). Germination after storage 2–3 months takes approx. 71 days, with about 572 seedlings per gram seed; sow seed in autumn, higher germination rate if seed is smoked (Greening Australia 1996b).

**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).

**Interaction with other organisms:** Leaves possibly eaten by rabbits (P. Kubiak pers. comm.). Tuberous roots reported eaten by Aboriginal people (Cribb & Cribb 1984).

**Distribution**

**Status/origin:** Native.

**Botanical subregions:** NC CC SC CT ST CWS SWS; Qld, Vic., Tas., S.A., W.A.

**Distribution Sydney area:** Widespread.

**Select locations:** CC: Doyalson, Somersby, Richmond, Berkshire Park, Hornsby, Wahroonga, Beacon Hill, Frenchs Forest, Concord, Helensburgh, Fitzroy Falls. **CT:** Orange, Carcoar, Barbers Creek (1898).

**Habitat**

**Habitat:** Swamps, heath.

**Altitude:** 0–900 m **Annual rainfall:** 800–1400 mm

**Typical local abundance:** Frequent.

**Vegetation:** Wet heath e.g. with *Geichenia dicarpa, Lepyrodia scariosa, Banksia oblongifolia, Eucalyptus haemastoma, Kunzea ambigua, Melaleuca nodosa.*

**Substrate:** Sandy clay soils on sandstone, Tertiary alluvium, shales, low nutrients, periodically moist.

**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown. Reported in Brisbane Water NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP.

## *Gloriosa superba* * COLCHICACEAE (LILIACEAE)

Glory Lily

**Life history**

**Growth form:** Herb with climbing stems 2–4 m long, glabrous.

**Vegetative spread:**

**Longevity:**

**Primary juvenile period:**

**Flowers:** Yellow, orange or red, October–May.

**Fruit/seed:** Capsule 4–10 mm long, with red seeds.

**Dispersal, establishment & growth:**

**Fire response:**

**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to Africa and Asia. Introduced as ornamental.

**Botanical subregions:** NC CC; LHI, Qld.

**Distribution Sydney area:**

**Select locations:** CC: Mosman (1989).

### Habitat

**Habitat:**
**Altitude:** 0–50 m **Annual rainfall:** 1200 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Widely cultivated as ornamental, occasionally naturalised, with only 1 record for Sydney area. However, a major weed in coastal vegetation on the North Coast (Jeff Thomas pers. comm., J. Hosking pers. comm.).

## ***Wurmbea biglandulosa*** (incl. in *Anguillaria dioica*) COLCHICACEAE (LILIACEAE)

### Life history

**Growth form:** Perennial herb to 30 cm high, with corm.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, September–October.
**Fruit/seed:** Capsule with brown seeds, October.
**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT ST NWS CWS SWS NWP; Qld, Vic.
**Distribution Sydney area:** Western Sydney.
**Select locations:** CC: Werrington, Penrith, St Marys, Parramatta (1881).

### Habitat

**Habitat:** Disturbed grassy places, creekbanks, rocky ridges.
**Altitude:** 0–50 m **Annual rainfall:** 700–900 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, Bursaria spinosa, Themeda australis.*
**Substrate:** Clay soil on Wianamatta Shale, medium nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Rare. Vulnerable in Western Sydney (James et al. 1999).

## ***Wurmbea dioica*** *(Anguillaria dioica)* **COLCHICACEAE** (LILIACEAE)

Early Nancy

### Life history

**Growth form:** Perennial herb to 30 cm high, with corm.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, September–October.
**Fruit/seed:** Capsule 5–10 mm long, with brown seeds. Mature summer (Greening Australia 1996b).
**Dispersal, establishment & growth:** Germination takes approx. 35 days, with high germination rate; sow seed in autumn (Greening Australia 1996b).
**Fire response:**
**Interaction with other organisms:** Small bulb reported eaten by Aboriginal people (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., S.A.
**Distribution Sydney area:**
**Select locations:** CC: Glen Davis, Marayong, Plumpton, St Marys, Parramatta, Homebush. CT: Bathurst, Georges Plains.

### Habitat

**Habitat:** Inland sand dunes, loam flats.
**Altitude:** 0–800 m **Annual rainfall:** 700–900 mm
**Typical local abundance:**
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, Bursaria spinosa, Themeda australis.*
**Substrate:** Clay soils on shale.
**Exposure:**

### Conservation

**Conservation:** Rarely recorded in Bathurst area, last record 1964.

## ***Aneilema acuminatum*** **COMMELINACEAE**

### Life history

**Growth form:** Weak, slender, perennial herb to 40 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, November–December. Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:** Flattened capsule 4 mm long, with pale grey seeds.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CWS; Qld.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Yarramalong, Mt Kembla.

### Habitat

**Habitat:** Moist gullies.
**Altitude:** 0–300 m **Annual rainfall:** 1100–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Rainforest e.g. with *Toona ciliata, Cryptocarya microneura, Acronychia oblongifolia.*
**Substrate:** Clay soils on shale.
**Exposure:**

### Conservation

**Conservation:** Rare, conservation status unknown.

## *Aneilema biflorum* COMMELINACEAE

### Life history

**Growth form:** Weak, prostrate to ascending perennial herb to 20 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, December–March. Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:** Flattened capsule 4 mm long, with pale grey seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT; Qld.
**Distribution Sydney area:**
**Select locations:** CC: Grose River, Menangle Creek, Mt Keira, Kiama, Cobbitty, Razorback.

### Habitat

**Habitat:** Damp, shaded places, creekbanks.
**Altitude:** 0–400 m **Annual rainfall:** 800–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Dry rainforest e.g. with *Streblus brunonianus, Maclura cochinchinensis.*
**Substrate:** Clay soil on shales, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Regionally rare in Illawarra region (Mills 1988). Conservation status elsewhere unknown. Reported in Royal NP.

## *Commelina africana* * COMMELINACEAE

### Life history

**Growth form:** Perennial herb with woody rootstock and prostrate or ascending stems.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, December–February. Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:** Capsule, with 3 seeds 3–4 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa (Ghana–S Africa).
**Botanical subregions:** CC.
**Distribution Sydney area:**
**Select locations:** CC: Berry Island (1992), Greenwich (1983).

### Habitat

**Habitat:**
**Altitude:** 0–50 m **Annual rainfall:** 1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Eucalyptus woodland e.g. with *Kunzea ambigua.*
**Substrate:** Sandy soil on sandstone.
**Exposure:**

### Conservation

**Conservation:** Garden escape, locally naturalised in the Greenwich area and Berry Island in eucalypt woodland, ability to spread unknown.

## *Commelina cyanea* COMMELINACEAE

Native Wandering Jew

### Life history

**Growth form:** Weak, procumbent, spreading herb, with stolons and fleshy roots at nodes.
**Vegetative spread:** Roots at nodes, able to spread several metres in a season but then dies back.
**Longevity:** Indefinite.
**Primary juvenile period:** 6 months.
**Flowers:** Blue, November–April. In summer, flowers open in the morning and close by mid-afternoon; probably pollinated by native bees and Honeybees *Apis mellifera* and possibly flies (P. Kubiak pers. comm.). Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:** Dry capsule, with 5 dull brown or black seeds 2–3 mm long.
**Dispersal, establishment & growth:** Diaspore: seed. Main growth period Summer, may die off in winter to resprout in Spring from stem remnants or possibly seeds. Growth rate quick. Coloniser of open areas.
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), flowering in 3 months (P. Kubiak pers. comm.).
**Interaction with other organisms:** Eaten by rabbits (P. Kubiak pers. comm.). Young shoots can be used as a cooked green vegetable, boiled and served with butter and salt (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT NWS CWS NWP; LHI, Qld.
**Distribution Sydney area:** Coast and adjacent plateaus.
**Select locations: CC:** Howes Valley, Richmond, Glenbrook, Beecroft, Nielsen Park, Kurnell, Kogarah, Campbelltown, Razorback, Kowmung, Bulli, Kangaroo Valley.

### Habitat

**Habitat:** Moist places, creek banks, disturbed areas.
**Altitude:** 0–400 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Open-forest e.g. with *Eucalyptus botryoides;* woodland e.g. with *Eucalytpus moluccana, E. tereticornis;* spreads in open areas with adequate moisture.
**Substrate:** Loamy to clay soils on sandstone, shale, volcanic necks, medium to high nutrients. Possibly somewhat salt-tolerant.
**Exposure:** Shade to full sun.

### Conservation

**Conservation:** Probably adequately conserved. Species survives well even in small, often weedy reserves. Reported in Blue Mountains NP, Bouddi NP, Lion Island NR, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Sydney Harbour NP.

## *Murdannia graminea* COMMELINACEAE

### Life history

**Growth form:** Erect, perennial herb 10–60 cm high, with tuberous roots.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Blue or purplish, rarely white, December–February. Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:** 3-valved capsule 6–10 mm long, with 12–15 greyish to dark brown seeds, matures summer. Seed weight 0.0011 g (Peter Lister pers. comm.).
**Dispersal, establishment & growth:** Diaspore: seed. No particular morphology for dispersal (McIntyre et al. 1995). Germination rapid, non-dormant fraction 44 % (Peter Lister pers. comm.).
**Fire response:**
**Interaction with other organisms:** Edible tuberous roots (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT NWS CWS NWP; Qld, N.T., W.A.
**Distribution Sydney area:** Mainly Richmond.
**Select locations:** CC: Richmond, Agnes Banks, Cowan (1921).

### Habitat

**Habitat:** Sandy soil liable to flooding.
**Altitude:** 0–50 m **Annual rainfall:** 800–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus tereticornis*, grassy understorey.
**Substrate:** Sandy soil from Tertiary alluvium, low nutrients. Water table mostly low, moisture supply intermittent, fresh.
**Exposure:** 40–60% projective foliage cover (P. Lister pers. comm.).

### Conservation

**Conservation:** Rare, vulnerable in Western Sydney (James et al. 1999). Not adequately conserved, recorded in Richmond area (1902, 1964, 1993), collected once at Cowan in 1921.

## *Pollia crispata* COMMELINACEAE

### Life history

**Growth form:** Perennial herb, with ascending stems to 1 m high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White or sometimes blue, October–March. Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:** Nut 5–6 mm long, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC CT; Qld.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Wyong, Mt Keira, Otford, Albion Park, Bulli, Minnamurra Falls, Cambewarra Range. CT: Belmore Falls.

### Habitat

**Habitat:** Wet places along creeks.
**Altitude:** 0–600 m **Annual rainfall:** 1200–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Rainforest e.g. with *Doryphora sassafras, Cryptocarya* sp., *Livistona australis*, or margins of rainforest.
**Substrate:** Clay soils on alluvium, basalt, medium to high nutrients.
**Exposure:**

### Conservation

**Conservation:** Cambewarra Range is southern geographical limit. Conservation status unknown.

## *Tradescantia fluminensis* * *(T. albiflora)* COMMELINACEAE

Wandering Jew

### Life history

**Growth form:** Weak, procumbent, succulent herb, with fine roots at nodes; similar to *Commelina* but leaves and stems more fleshy.
**Vegetative spread:** Stem breaks easily at nodes, then roots and grows rapidly (Buchanan 1981).
**Longevity:** Perennial.
**Primary juvenile period:**
**Flowers:** White, October–January. Flowering may be supressed in heavily shaded areas; probably pollinated by Honeybees *Apis mellifera* and Hoverflies (Syrphidae) and possibly by small native bees (P. Kubiak pers. comm.). Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:** Papery capsule.
**Dispersal, establishment & growth:** Mainly dispersed by stem fragments.
**Fire response:** Fleshy nature makes it difficult to burn. Resprouted after high intensity fire in 1994 (at Lane Cove), with peak flowering in 3 years (P. Kubiak pers. comm.).
**Interaction with other organisms:** Shoots eaten by rabbits (P. Kubiak pers. comm.). Provides sheltered, moist habitat for Paralysis Tick *Ixodes holocyclus* (B. Conroy pers. comm.).

### Distribution

**Status/origin:** Exotic, native to S America. Garden escape.
**Botanical subregions:** NC CC SC CT NWS; LHI, Qld, Vic., Tas.
**Distribution Sydney area:** Common weed in shaded and disturbed sites around Sydney
**Select locations:** **CC:** Yarramalong, Pennant Hills, Milperra, Bowens Creek, Shellharbour, Kangaroo Valley. **CT:** Katoomba.

### Habitat

**Habitat:** Creeks and drainage lines, moist disturbed sites.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Forest and woodland, edge of rainforest e.g. with *Doryphora sassafras, Ceratopetalum apetalum.*
**Substrate:** Higher nutrient soils, alluvium, shale, or enriched sandstone.
**Exposure:** Full sun–deep shade.

### Conservation

**Conservation:** Widely naturalised on creek banks and in shaded places.Troublesome weed capable of choking out low-growing native species. Prevents germination of native species (Standish et al. 2001).

## *Tradescantia zebrina* * *(Zebrina pendula)* COMMELINACEAE

Zebrina

### Life history

**Growth form:** Creeping, succulent herb, with branching stems rooting at the nodes.
**Vegetative spread:** Stoloniferous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pink to purplish, February and August. Flowers of Commelinaceae species are short-lived and lack nectar, providing only pollen as a reward for the insect pollinators (Faden 2000).
**Fruit/seed:**
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Mexico and C America. Introduced as ornamental.
**Botanical subregions:** NC CC; LHI, Qld.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Minnamurra Falls (1953).

### Habitat

**Habitat:** Rainforest.
**Altitude:** 0–300 m **Annual rainfall:** 1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Rainforest.
**Substrate:** Clay soils on shale, alluvium.
**Exposure:**

### Conservation

**Conservation:** Cultivated as ornamental, occasionally locally naturalised e.g. at Minnamurra Falls.

## *Abildgaardia ovata* (*Fimbristylis ovata*) CYPERACEAE

### Life history

**Growth form:** Tufted, glabrous perennial herb, with a very short rhizome, forming tussocks; flowering stems 6–40 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 2–3 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC **CC:** Qld, N.T., pantrop.
**Distribution Sydney area:** Coastline.
**Select locations:** **CC:** Barrenjoey (1972), Austinmer (1965).

### Habitat

**Habitat:** Coastal headlands.
**Altitude:** 0–50 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Coastal headland grassland e.g. with *Themeda australis, Lomandra longifolia.*
**Substrate:** Clayey soils on shales or sandstones, medium nutrients.
**Exposure:** Exposed sites.

### Conservation

**Conservation:** Not common in NSW, Austinmer is southern geographical limit. Conservation status unknown.

## *Baumea acuta* CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb, with long creeping rhizome; flowering stems 15–35 cm high.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** September–February, peak October.
**Fruit/seed:**
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC ST; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** CC: Mellong Swamp, Agnes Banks, West Head (Salvation Track), Centennial Park, La Perouse, Kogarah, Picnic Point, Loftus, Hill Top, Barren Grounds.

### Habitat

**Habitat:** Swamps and damp heath.
**Altitude:** 0–500 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Cyathochaeta diandra, Ptilanthelium deustum, Schoenus paludosus;* low woodland e.g. with *Eucalyptus parramattensis.*
**Substrate:** Sandy soils, low nutrients, poorly-drained.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Baumea arthrophylla* CYPERACEAE

### Life history

**Growth form:** Perennial herb with long creeping rhizome; flowering stems 30–100 cm high. Often confused with *B. rubiginosa* but the nuts differ (Harden 1993).
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** July–January, peak December.
**Fruit/seed:** Nut 2–3 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Plays an important role in transfer of methane from sediments to the atmospere (Muller et al. 1994).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic., Tas., S.A., W.A., N.Z.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Porters Creek, Wyong, Dee Why Lagoon, La Perouse, Kurnell, Thirlmere.

### Habitat

**Habitat:** Swamps.
**Altitude:** 0–200 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Occasional–frequent.
**Vegetation:** Sedgeland e.g. with *Baumea articulata, Baumea teretifolia; Melaleuca* scrub e.g. with *Callistemon citrinus.*
**Substrate:** Sandy soils, with periodic standing water, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## ***Baumea articulata*** *(Cladium articulatum)* CYPERACEAE

Jointed Twig-rush

### Life history

**Growth form:** Perennial herb, with stout rhizome; flowering stems 90–200 cm high.
**Vegetative spread:** Spreading rhizomes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 2–3 mm long.
**Dispersal, establishment & growth:** Germination of seed stimulated by smoke (Greening Australia 1996).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS; Qld, Vic., Tas., S.A., W.A., N.Z., N.G., N. Cal., Vanuatu.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Morisset, Budgewoi, Wyong, Umina, Manly Dam, Cooks River, Towra Point, Kurnell, Liverpool, Wollongong, Thirlmere Lakes. **CT:** Fitzroy Falls.

### Habitat

**Habitat:** Standing water of lagoons, swamps and streams.
**Altitude:** 0–700 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** *Melaleuca* swamp e.g. with *Melaleuca quinquenervia;* sedgeland e.g. with *Schoenus brevifolius, Leptocarpus tenax, Blechnum indicum, Calochlaena dubia.*
**Substrate:** Sandy soils with standing water or permanently moist, low nutrients, fresh.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Only record for CT, at Fitzroy Falls, is in rocklined drain, distributed by construction works (Herb. note). Reported in Garigal NP, Royal NP.

## *Baumea gunnii* (*Cladium gunnii*) CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb, with short rhizome; flowering stems 20–100 cm high.
**Vegetative spread:** Spreading rhizomes.
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** November–June.
**Fruit/seed:** Nut 3–4 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS; Qld, Vic., Tas., S.A., N.G., N Cal.
**Distribution Sydney area:** Coast and Boyd Plateau.
**Select locations:** **CC:** Centennial Park, La Perouse, Kurnell, Kogarah Bay, Appin. **CT:** Hampton, Boyd Plateau, Jenolan Caves.

### Habitat

**Habitat:** Swamps and near watercourses.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Wet heath e.g. with *Banksia robur, Gleichenia dicarpa, Chorizandra cymbaria, Hakea teretifolia;* sedgeland e.g. with *Carex appressa, Xyris ustulata, Empodisma minus, Baumea rubiginosa;* swamp e.g. with *Baumea juncea, Blechnum indicum, Phragmites australis.*
**Substrate:** Sandy soils, low nutrients, poorly-drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Baumea johnsonii* CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb, with short rhizome; flowering stems 30–140 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** July–March.
**Fruit/seed:** Nut 3–4 mm long, August–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC CT.
**Distribution Sydney area:** Blue Mountains.
**Select locations:** **CC:** Mt Irvine, Carrington Falls. **CT:** Mt Wilson, Blackheath, Wentworth Falls, Linden.

### Habitat

**Habitat:** Damp areas below sandstone cliffs, moist cliff faces.
**Altitude:** 500–1000 m **Annual rainfall:** 1100–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Cliff-face vegetation e.g. with *Empodisma minus, Gleichenia rupestris, Dracophyllum secundum;* sedgeland e.g. with *Gymnoschoenus sphaerocephalus, Schoenus melanostachys, Gleichenia microphylla.*
**Substrate:** Sandstone, cliffs and overhangs, with low nutrients, permanent moisture.
**Exposure:** Sheltered positions.

### Conservation

**Conservation:** Local endemic species restricted to Upper Blue Mountains and Carrington Falls area. Conservation status unknown. Reported in Blue Mountains NP.

## *Baumea juncea* (*Cladium junceum*) CYPERACEAE

### Life history

**Growth form:** Slender perennial herb with long creeping rhizome; flowering stems to 90 cm high, leaves basal and cauline.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** October–January.
**Fruit/seed:** Nut 3 mm long, October–March.
**Dispersal, establishment & growth:**
**Fire response:** Resprouts from rhizome (Herb. record), mature in about 1 year (P. Kubiak pers. comm).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT; LHI, Qld, Vic., Tas., S.A., W.A., ?NI, N.Z., N. Cal.
**Distribution Sydney area:** Widespread on coast.
**Select locations:** CC: Morisset, Budgewoi, Crosslands, Narrabeen, Manly, La Perouse, Kurnell, Kogarah Bay, Casula, Austinmer, Tahmoor.

### Habitat

**Habitat:** Fresh to brackish swamps.
**Altitude:** 0–300 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Estuarine sedgeland with *Juncus kraussii*, or landward with *Sporobolus virginicus, Phragmites communis*, or under *Casuarina glauca* (Clarke & Hannon 1967) or with *Melaleuca quinquenervia;* freshwater swamp e.g. with *Baumea rubiginosa;* wet heath e.g. with *Banksia ericifolia, Eurychorda complanata (Restio complanatus).*
**Substrate:** Brackish or saline swamps with sandy to silty soils, low nutrients.
**Exposure:** Full sun to light shade

### Conservation

**Conservation:** Conservation status unknown. Reported in Brisbane Water NP, Marramarra NP, Muogamarra NR, Garigal NP, Lane Cove NP, Sydney Harbour NP, Royal NP.

## *Baumea muelleri* (*Cladium muelleri*) CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb, with short rhizome; flowering stems 10–60 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October.
**Fruit/seed:** Dark brown to blackish nut 3–4 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld.
**Distribution Sydney area:** Coastal.
**Select locations:** CC: Mona Vale (1977).

### Habitat

**Habitat:** Wet areas.
**Altitude:** 0–50 m **Annual rainfall:** 1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Gahnia erythrocarpa, Gahnia sieberiana, Baumea nuda.*
**Substrate:** Sandy soils on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Southern geographical limit is Oxford Falls (Harden 1993). Conservation status unknown.

## *Baumea nuda* (*Schoenus nudus*) CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb with short rhizome; flowering stems to 40 cm high, with basal leaves to twice as long as flowering stems.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:** Resprouts from rhizome.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Qld.
**Distribution Sydney area:** Coast and Upper Blue Mountains.
**Select locations:** **CC:** West Head (Salvation Loop Track), Cheltenham, South Turramurra, La Perouse, Campbelltown, Waterfall, Mt Keira. **CT:** Clarence, Blackheath, Wentworth Falls, Lawson

### Habitat

**Habitat:** In swamps or along streams.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Wet heath e.g. with *Sprengelia incarnata, Epacris obtusifolia, Leptocarpus tenax, Lepyrodia scariosa;* creekside vegetation e.g. with *Restio complanatus, Callistemon citrinus, Baeckea linifolia;* open-forest e.g. with *Eucalyptus piperita, Angophora costata.*
**Substrate:** Sandy soil on sandstone, low nutrients, periodically wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Ku-ring-gai Chase NP, Royal NP.

## *Baumea planifolia* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with stems to 1.2 m high; long creeping rhizome.
**Vegetative spread:** Long-creeping rhizomes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** August–December.
**Fruit/seed:** Nut to 2 mm long, August–December.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST; Qld, Vic.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Bowens Creek, Silverdale, Tahmoor. **CT:** Dunns Swamp.

### Habitat

**Habitat:** Swamps, near streams.
**Altitude:** 0–800 m **Annual rainfall:** 800–1000 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Shrubby swamp e.g. with *Leptospermum polygalifolium, Leptospermum obovatum, Baumea rubiginosa, Gleichenia.*
**Substrate:** Sandy soils on alluvium, sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Wollemi NP.

## ***Baumea rubiginosa*** CYPERACEAE

### Life history

**Growth form:** Perennial herb, with stems to 110 cm high; short stout rhizome.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** July–April. Flowers abundantly only after fire (Keith 1996).
**Fruit/seed:** November–April.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 2 years (D. Keith pers. comm.), flowering in 10 months (at Lane Cove and Narrabeen, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST CWS SWS; Qld, Vic., Tas., N.T., S.A., W.A., N.Z., N Cal.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Morisset, Woy Woy, Porters Creek, Dural, St Ives, Centennial Park, Kurnell, East Lakes, Kogarah, Loftus, Darkes Forest, Carrington Falls. **CT:** Coricudgy, Clarence, Katoomba, Wingecarribee Swamp, Mittagong, Barbers Creek.

### Habitat

**Habitat:** Swamps, creeks.
**Altitude:** 0–1200 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedge swamp e.g. with *Baumea articulata, Schoenus brevifolius, Gleichenia dicarpa, Banksia robur;* upland shrubswamp e.g. with *Xyris ustulata, Gymnoschoenus sphaerocephalus, Grevillea acanthifolia, Empodisma minus;* sedgeland e.g. with *Eleocharis sphacelata, Baumea arthrophylla;* swamp forest e.g. with *Eucalyptus robusta, Melaleuca ericifolia;* saltmarsh e.g. with *Phragmites australis, Casuarina glauca.*
**Substrate:** Sandy, peaty soil, low nutrients, poorly-drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Brisbane Water NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Royal NP.

## *Baumea teretifolia* (*Cladium teretifolium*) CYPERACEAE

### Life history

**Growth form:** Perennial herb, with stems to 1 m high.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** July–December. Flowers abundantly only after fire (Keith 1996).
**Fruit/seed:** Nut 2 mm long, October–April.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC ?NT CT; Qld, N.Z., N.G.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Morisset, Porters Creek, Somersby, Centennial Park, La Perouse, Kurnell, Jibbon, Thirlmere Lakes, Maddens Plains, Barren Grounds NR. **CT:** Robertson.

### Habitat

**Habitat:** Swamp, damp places.
**Altitude:** 0–700 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedge swamp e.g. with *Chorizandra sphaerocephala, Empodisma minus, Gleichenia dicarpa, Schoenus brevifolius, Gymnoschoenus sphaerocephalus;* swamp forest e.g. with *Eucalyptus robusta, Melaleuca ericifolia.*
**Substrate:** Sandy, peaty soils, low nutrients, poorly-drained. Colonises low pH (2.5–6.5) acid sulphate estuarine soils in the Wyong area (Payne 1992).
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP, Barren Grounds NR.

## *Baumea tetragona* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with stems to 1 m high; long rhizome.
**Vegetative spread:** Spreading rhizomes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT; Qld, Vic., Tas., S.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Bargo (1966). **CT:** Dunns Swamp (1997), Mt Wilson (1907).

### Habitat

**Habitat:** Swamps, creekbeds.
**Altitude:** 400–1000 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swamp e.g. with *Baumea rubiginosa, Eleocharis sphacelata, Carex appressa, Eucalyptus camphora, Leptospermum polygalifolium.*
**Substrate:** Sandy alluvium, low nutrients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Rare, conservation status unknown. Reported in Wollemi NP.

## ***Bolboschoenus caldwellii*** *(Scirpus caldwellii)* **CYPERACEAE**

### Life history

**Growth form:** Perennial herb, with stems usually to 90 cm; rhizomatous.
**Vegetative spread:** Spreading rhizomes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** February–October.
**Fruit/seed:** Nut 4 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A., N.Z.
**Distribution Sydney area:** Mainly coastal.
**Select locations: CC:** Toongabbie, East Hills, Port Botany, Kurnell, Woolooware Bay, Camden. CT: Glen Davis.

### Habitat

**Habitat:** Estuarine swamps, drains, creeklines.
**Altitude:** 0–300 m **Annual rainfall:** 600–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Estuarine sedgeland e.g. with *Juncus kraussii, Melaleuca ericifolia, Melaleuca linariifolia, Typha;* riverflat forest e.g. with *Eucalyptus tereticornis, Casuarina glauca, Melaleuca nodosa, Melaleuca styphelioides.*
**Substrate:** Clay soil on shale, medium nutrients, periodically wet, saline–brackish. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## ***Bolboschoenus fluviatilis*** *(Scirpus fluviatilis)* **CYPERACEAE**

### Life history

**Growth form:** Perennial herb with stems to 2 m high; rhizomatous.
**Vegetative spread:** Creeping rhizome.
**Longevity:** Probably indefinite.
**Primary juvenile period:**
**Flowers:** November–December.
**Fruit/seed:** Nut 4 mm long, August–March.
**Dispersal, establishment & growth:** Growth rate quick. Coloniser.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC ST NWS NWP SWP; Qld, Vic., N.Z., Asia, N. Amer.
**Distribution Sydney area:** Sporadic.
**Select locations: CC:** Windsor (DHB), Richmond (DHB), Berkshire Park, Riverstone (1909), Centennial Park, Dapto (1972).

### Habitat

**Habitat:** Swamps, creekbed.
**Altitude:** 0–1000 m **Annual rainfall:** 700–900 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. *Phragmites australis.*
**Substrate:** Clay soils on alluvium, medium nutrients. Water table mostly high, moisture supply intermittent, fresh.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Bolboschoenus medianus* (*Scirpus medianus*) CYPERACEAE

### Life history

**Growth form:** Perennial herb with solitary stems 70–150 cm high, arising along rhizomes.
**Vegetative spread:** Rhizomatous spread.
**Longevity:**
**Primary juvenile period:**
**Flowers:** April.
**Fruit/seed:** Nut 4 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT ST CWS NWP SWP NFWP SFWP; Vic., Tas., S.A., N.Z.
**Distribution Sydney area:** Glen Davis.
**Select locations:** CC: Glen Davis.

### Habitat

**Habitat:** Creekbed.
**Altitude:** 0–100 m **Annual rainfall:** 600 mm
**Typical local abundance:** Abundant.
**Vegetation:** Riparian vegetation e.g. with *Casuarina cunninghamiana, Schoenoplectus validus, Typha orientalis.*
**Substrate:** Sandy alluvium.
**Exposure:**

### Conservation

**Conservation:** Only one record, Glen Davis (1994).

## *Bulbostylis barbata* CYPERACEAE

### Life history

**Growth form:** Slender, tufted herb, with stems to 30 cm high.
**Vegetative spread:**
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** June.
**Fruit/seed:** Nut less than 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT NWS CWS NWP SWP NFWP; Qld, N.T., S.A., W.A., Old World trop., & U.S.A.
**Distribution Sydney area:** Agnes Banks.
**Select locations:** CC: Agnes Banks (1975).

### Habitat

**Habitat:**
**Altitude:** 0–100 m **Annual rainfall:** 700–800 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Sandy soil, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Only one record for Sydney area (at Agnes Banks 1975) and now probably extinct there as a result of sand extraction.

## *Bulbostylis densa* CYPERACEAE

### Life history

**Growth form:** Slender, tufted annual herb, with flowering stems 5–40 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT; LHI, Qld, Asia & tropical Africa.
**Distribution Sydney area:** Wyee.
**Select locations:** **CC:** Wyee (1993).

### Habitat

**Habitat:** Rocky hillsides or streams.
**Altitude:** 0–100 m **Annual rainfall:** 1100 mm
**Typical local abundance:** Rare.
**Vegetation:** Roadside vegetation e.g. with *Chloris gayana.*
**Substrate:** Sandy loam.
**Exposure:**

### Conservation

**Conservation:** Wyee is southern geographical limit and the only record for Sydney area.

## *Carex appressa* CYPERACEAE

### Life history

**Growth form:** Herb, with stems 40–120 cm high; rhizome short with densely tufted shoots.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** September–December.
**Fruit/seed:** Nut within membranous sack, December–January.
**Dispersal, establishment & growth:** Diaspore: fruit, no special dispersal morphology (Westoby et al. 1990). Seeds germinate easily with no special treatment (A. Lewis pers. comm.).
**Fire response:**
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla ornata ornata, Heteronympha cordace cordace* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., Tas., S.A., W.A., N.G., N.Z., N. Cal.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Colo River, Narara Creek, Grose Vale, Shane Park, Towra Point, Glenbrook, Manly, Kogarah (1893), Doonside, Otford, Cambewarra. **CT:** Mt Wilson, Mt Werong, Oberon, Boyd Plateau, Hill Top, Wingecarribee Swamp, Wingello.

### Habitat

**Habitat:** Wetlands, creekbanks.
**Altitude:** 0–1200 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Floodplain swamp e.g. with *Juncus usitatus, Elaeocharis sphacelata, Melaleuca linariifolia,* moist eucalypt forest e.g. with *Eucalyptus deanei, E. tereticornis E. amplifolia, Casuarina glauca* and montane swamps e.g. with *Leptospermum obovatum, Restio australis.*
**Substrate:** Clay loam on shale, rocky stream beds, alluvial, and organic sediments on granite, low to medium nutrients. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:** Full sun–mid-shade.

### Conservation

**Conservation:** Conservation status unknown.

## *Carex bichenoviana* CYPERACEAE

### Life history

**Growth form:** Loosely tufted herb, with long rhizome; stems to 40 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Male and female flowers usually on same plant, with one flower in each spikelet.
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Not readily eaten by stock (Herb. note).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST NWS CWS SWS SWP; Vic., Tas., S.A.
**Distribution Sydney area:** Bathurst area.
**Select locations:** CT: Bathurst (1995), Evans Plains (1996), Carcoar (1966).

### Habitat

**Habitat:** Creekbanks.
**Altitude:** 800 m **Annual rainfall:** 700 mm
**Typical local abundance:** Frequent.
**Vegetation:** Exotic grasses.
**Substrate:** Sandy to silty soils on alluvium.
**Exposure:**

### Conservation

**Conservation:** Few collections, appears to be rare.

## *Carex breviculmis* CYPERACEAE

### Life history

**Growth form:** Densely tufted perennial herb with short rhizome; leaves to 35 cm high and flowering stems usually 3–10 cm long.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** September–October.
**Fruit/seed:** Triangular nut, September–December.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS; LHI, Qld, Vic., Tas., Asia & Pacific.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Vineyard, Middle Head, Otford, Campbelltown, Picton, Albion Park, Berry. CT: Mt Coricudgy, Mt Canobolas, Georges Plains, Oberon, Mount Tomah.

### Habitat

**Habitat:** Ridges, hillsides.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, E. tereticornis, Angophora costata, Eucalyptus blakelyi;* open-forest e.g. with *Eucalyptus viminalis.*
**Substrate:** Clay soils on shale, basalt, medium to high nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Carex brunnea* *(C. hattoriana)* CYPERACEAE

### Life history

**Growth form:** Densely tufted herb, with short rhizome; stems to 80 cm, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–April.
**Fruit/seed:** Nut, January–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla ornata ornata* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; LHI, Qld.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wyong, Waterfall, Mt Keira, Minnamurra Falls, Jamberoo. **CT:** Govetts Leap, Wentworth Falls, Macquarie Falls.

### Habitat

**Habitat:** Creeks, gullies.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1800 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Rainforest e.g. with *Ceratopetalum apetalum, Doryphora sassafras, Acmena smithii, Gahnia* species.
**Substrate:** Clay to loam soil, medium to low nutrients, moist conditions.
**Exposure:** Shaded.

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Carex declinata* CYPERACEAE

### Life history

**Growth form:** Densley tufted herb, with short rhizome; stems to 120 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** March.
**Fruit/seed:** Nut, March.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Werong Beach (1978), Razorback (1976, 1986), Albion Park (1948).

### Habitat

**Habitat:** Gullies.
**Altitude:** 0–300 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Moist eucalypt rainforest e.g. with *Eucalyptus botryoides;* rainforest margins.
**Substrate:** Clay soils on shale, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Rare, known from only a few localities in Sydney area. Reported in Royal NP.

## *Carex echinata* CYPERACEAE

Star Sedge

### Life history

**Growth form:** Densely tufted herb, with very short rhizome; stems usually to 30 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January.
**Fruit/seed:** Nut, January.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic., N.G., N.Z., N Hemi.
**Distribution Sydney area:** Clarence.
**Select locations:** **CT:** Clarence (1961, 1995).

### Habitat

**Habitat:** Swamp.
**Altitude:** 1000 m **Annual rainfall:** 1100 mm
**Typical local abundance:** Occasional.
**Vegetation:** Shrub swamp e.g. with *Leptospermum obovatum, Leptospermum juniperinum, Gahnia grandis, Restio australis.*
**Substrate:** Peaty soil over sandstone, low nutrients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Rare, conservation status unknown, species refound in 1995 after about 30 years at only known CT locality.

## *Carex fascicularis* CYPERACEAE

Tassel Sedge

### Life history

**Growth form:** Densely tufted herb, with short rhizome; stems to 1 m long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS; Qld, Vic., Tas., S.A., W.A., N.G., N.Z.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Cooranbong, Windsor, Cheltenham, Kogarah, Douglas Park. **CT:** Jenolan Caves, Wombeyan Caves, Wingecarribee Swamp, Wildes Meadow.

### Habitat

**Habitat:** Swampy areas, creekbanks.
**Altitude:** 0–800 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Sedgeland e.g. with *Eleocharis sphacelata, Villarsia reniformis, Myriophyllum variifolium, Lythrum salicaria, Lycopis australis.*
**Substrate:** Clay soils on alluvium, medium nutrients, poorly drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Carex gaudichaudiana* CYPERACEAE

### Life history

**Growth form:** Tufted herb, with long rhizome; stems to 90 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:** Long spreading rhizomes.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** September–April.
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Food plant of butterfly larvae *Taractrocera papyria papyria* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS SWS; Qld, Vic., Tas., N.G., N.Z., Asia.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Putty, Porters Creek, Maraylya, Casula, Menangle Park, Minnamurra River. CT: Dunns Swamp, Mt Canobolas, Lawson, Kanangra Walls, Boyd Plateau, Mt Werong, Wingecarribee Swamp.

### Habitat

**Habitat:** Swamps, creek banks.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Eleocharis acuta, Restio australis, Carex appressa, Eleocharis sphacelata, Chorizandra cymbaria.*
**Substrate:** Sandy to peaty substrates, periodic open-water, medium nutrients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Carex incomitata* CYPERACEAE

### Life history

**Growth form:** Loosely tufted herb, with short rhizome; stems 90 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November.
**Fruit/seed:** Nut, November.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** SC NT CT ST NWS CWS SWS; Vic.
**Distribution Sydney area:** Western Blue Mountains.
**Select locations:** CT: Mt Cameron, Jenolan Caves, Hampton, Gibraltar Rocks, Abercrombie Caves.

### Habitat

**Habitat:** Creeks, gullies, grassy sites.
**Altitude:** 600–1000 m **Annual rainfall:** 900–1100 mm
**Typical local abundance:** Rare–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus viminalis, E. radiata, E. fastigata.*
**Substrate:** Sandy loam on granite, basalt, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Carex inversa* CYPERACEAE

### Life history

**Growth form:** Perennial herb with long rhizome; flowering stems 10–50 cm high, with shorter leaves.
**Vegetative spread:** Yes (McIntyre et al. 1995).
**Longevity:** Indefintite.
**Primary juvenile period:**
**Flowers:** September–May, peak March.
**Fruit/seed:** Triangular nut, September–May.
**Dispersal, establishment & growth:** Mechanism for dispersal undefined (McIntyre et al. 1995).
**Fire response:** Possibly resprouted after high intensity fire 1994 (at Lane Cove), flowering in 4 months (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; LHI, Qld, Vic., Tas., S.A., W.A., Norfolk Is., N.Z.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Hornsby, Cheltenham, Homebush, Oatley, Penrith, Liverpool, Casula, Campbelltown, Razorback, Berry. **CT:** Kelgoola, Orange, Glanmire, Hartley, Mt Wilson, Wombeyan Caves.

### Habitat

**Habitat:** Grassy woodland, creeks.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassy woodland e.g. with *Eycalyptus moluccana, E. tereticornis, E. crebra, E. pauciflora, E. rubida;* grassland.
**Substrate:** Clay soils on shale, granite, volcanics, medium to high nutrients, well-drained. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Conserved in Western Sydney (James et al. 1999). Conservation elsewhere unknown.

## *Carex iynx* CYPERACEAE

### Life history

**Growth form:** Densely tufted herb, with short rhizome; stems 1 m long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** April, November.
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** SC CT ST; Vic., Tas., ?*S.A.
**Distribution Sydney area:** Tablelands.
**Select locations: CT:** Oberon, Kanangra Boyd, Blayney.

### Habitat

**Habitat:** Creekbanks, edge of floodplain.
**Altitude:** 800–1000 m **Annual rainfall:** 800–1000 mm
**Typical local abundance:** Occasional.
**Vegetation:** Grassland e.g. with *Carex appressa, Baumea gunnii, Juncus australis, Poa.*
**Substrate:** Clay soil on alluvium, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Oberon is northern geographical limit, conservation status unknown. Reported in Kanangra Boyd NP.

## *Carex klaphakei* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with long rhizome; slender stems to 160 cm long, triangular in cross section, with leaves mostly basal. Grossly resembles introduced species *C. divisa,* which has larger inflorescences and is not as slender (Wilson 1996).
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** April.
**Fruit/seed:** Nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CT.
**Distribution Sydney area:** Tablelands.
**Select locations:** CT: Blackheath, Mt Werong, Penrose.

### Habitat

**Habitat:** Swamps.
**Altitude:** 600–1200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Empodisma minus, Gleichenia dicarpa, Eleocharis gracilis, Juncus falcatus, Restio australis, Carex gaudichaudiana.*
**Substrate:** Peaty sand on sandstone, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Local endemic species, known only from Blackheath, Mt Werong, Penrose, listed as Endangered (Schedule 1) NSW Threatened Species Conservation Act 1995. Part of a population is in Kanangra-Boyd NP. Reported in Blue Mountains NP.

## *Carex lobolepis* CYPERACEAE

### Life history

**Growth form:** Loosely tufted herb, with short rhizome; stems to 90 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** April.
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC NT CT; Qld.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** CT: Mt Wilson, Boyd River, Mt Werong.

### Habitat

**Habitat:** Swamps, creekbanks.
**Altitude:** 1200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Baumea rubiginosa, Carex inversa, Carex appressa.*
**Substrate:** Sandy soil, or alluvium, low nutrients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Boyd Plateau is southern geographical limit. Reported in Kanangra Boyd NP.

## *Carex longebrachiata* CYPERACEAE

### Life history

**Growth form:** Densely tufted herb, with short rhizome; stems to 80 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–December.
**Fruit/seed:** Nut, October–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS; Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Wyong, Grose Vale, Northmead, Glenbrook, Wongawilli, Kiama, Kangaroo Valley, Nowra. CT: Mt Canobolas.

### Habitat

**Habitat:** Low-lying areas, creeks, gullies.
**Altitude:** 0–1500 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, E. tereticornis, Melaleuca linariifolia;* open-forest e.g. with *Eucalyptus pauciflora.*
**Substrate:** Sandy to clay soil on alluvium, shale, siltstone, volcanics, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999).

## *Carex maculata* *(C. neurochlamys)* CYPERACEAE

### Life history

**Growth form:** Densely tufted, perennial herb with short rhizome; stems usually to 40 cm high, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut, December–March (limited data).
**Dispersal, establishment & growth:** Diaspore:
Dispersal: no special morphology (Westoby et al. 1990).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, N.G., N Caledonia.
**Distribution Sydney area:** Wyong area, Lower Blue Mountains.
**Select locations:** **CC:** Watagan SF, Martinsville, Ourimbah Creek, North Richmond, Bowen Mountain, Springwood.

### Habitat

**Habitat:** Creeks and gullies.
**Altitude:** 0–300 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Moist eucalypt forest e.g. with *Eucalyptus punctata, Angophora floribunda, Eucalyptus globoidea;* gully rainforest e.g. with *Ceratopetalum apetalum, Tristaniopsis laurina, Backhousia myrtifolia.*
**Substrate:** Sandy to loamy soil on Narrabeen Group, Hawkesbury sandstone, medium nutrients. Water table mostly high, moisture supply intermittent, fresh.
**Exposure:** Sheltered situations; mid shade.

### Conservation

**Conservation:** Southern limit Springwood. Conservation status unknown.

## *Carex ovalis* * CYPERACEAE

### Life history

**Growth form:** Densely tufted herb, with short rhizome; stems usually to 60 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut, January.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe.
**Botanical subregions:** CT; Vic., Tas.
**Distribution Sydney area:** Southern Highland.
**Select locations:** **CT:** Robertson (1996), Wildes Meadow (1993).

### Habitat

**Habitat:** Damp sites, streams, channels.
**Altitude:** 600–800 m **Annual rainfall:** 1600 mm
**Typical local abundance:** Rare.
**Vegetation:** Riparian vegetation e.g. with *Juncus.*
**Substrate:** Alluvium, partially inundated, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Naturalised near Robertson (Harden 1993), ability to spread further is unknown.

## *Carex polyantha*

CYPERACEAE

### Life history

**Growth form:** Densely tufted herb, with long rhizome; stems to 80 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:** Adventitious rhizomes spread locally to from clumps (Herb. note).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:** Mechanism for dispersal undefined (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS; Qld, Vic.
**Distribution Sydney area:** Widespread but sporadic.
**Select locations:** **CC:** Bendeela. **CT:** Hartley, Church Creek, Yerranderie.

### Habitat

**Habitat:** Swamps, creekbanks.
**Altitude:** 0–700 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Riparian vegetation e.g. with *Casuarina cunninghamiana, Eucalyptus viminalis, E. stellulata.*
**Substrate:** Sandy alluvium, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Carex pumila*

CYPERACEAE

### Life history

**Growth form:** Loosely tufted herb, with very long rhizome; leaves longer than stems, triangular in cross section, with leaves mostly basal.
**Vegetative spread:** Long, creeping rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** October.
**Fruit/seed:** Nut, October–March.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC ST; LHI, Qld, Vic., Tas., S.A., S America, Asia, N.Z.
**Distribution Sydney area:** Shoreline.
**Select locations:** **CC:** Budgewoi, Narrabeen, Bondi (1915), Maroubra, La Perouse, Kurnell, Padstow, Otford, Shellharbour, Gerringong.

### Habitat

**Habitat:** Coastal sand dunes, behind beaches.
**Altitude:** 0–50 m **Annual rainfall:** 1200–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Foredune vegetation e.g. with *Spinifex hirsutus, Trachyandra;* edge of *Melaleuca quinquenervia* swamp.
**Substrate:** Sandy soil on dunes, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Botany Bay NP, Georges River NP.

## *Carex tereticaulis* CYPERACEAE

### Life history

**Growth form:** Densely tufted herb, with thick rhizome; stems to 120 cm long, triangular in cross section, with leaves mostly basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT ST SWS SWP; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Kogarah.
**Select locations:** CC: Kogarah (1893), Arnciffe (1893).

### Habitat

**Habitat:** Low-lying, seasonally inundated areas.
**Altitude:** 0–100 m **Annual rainfall:** 1000–1100 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Recorded only from Kogarah Swamp and Arncliffe in 1893, now probably extinct in Sydney area.

## *Caustis flexuosa* CYPERACEAE

Curly Wig

### Life history

**Growth form:** Rhizomatous perennial herb, with short rhizome; stems to 90 cm high, with leaves reduced to sheaths along, and at base of stems.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:** 2 years (P. Kubiak pers. comm.).
**Flowers:** Flowers in spikelets.
**Fruit/seed:** Nut 5 mm long.
**Dispersal, establishment & growth:** Diaspore: nut. Seedlings may be common after fire. No special morphology (Westoby et al. 1990).
**Fire response:** Killed and restablished from ?soil-stored seed in coastal areas (e.g. at Leura Swamp (DHB 1985).
**Interaction with other organisms:** Shoot damage by rabbits but not eaten (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS; Qld, Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Culoul Range, Wheeny Creek, Gosford, West Head, Berowra, Springwood, Glenbrook, Hornsby, Manly, Five Dock (1883), Rose Bay (1900), Oatley, Woronora River, Avon Dam. **CT:** Currant Mountain Gap, Gospers Mountain, Glen Davis, Mt Wilson, Blackheath, Katoomba, Mittagong, Bundanoon, Tallong.

### Habitat

**Habitat:** Ridges, hillsides, rocky outcrops.
**Altitude:** 0–1100 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open forest e.g. with *Eucalyptus sieberi, E. piperita, Corymbia eximia, Banksia serrata, Eucalyptus sparsifolia, Angophora costata;* heath e.g. with *Banksia ericifolia, Banksia oblongifolia.*
**Substrate:** Sandy soils from sandstone, granite, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Probably adequately conserved. Reported in Wollemi NP, Blue Mountains NP, Brisbane Water NP, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Dalrymple Hay NR, Lane Cove NP, Sydney Harbour NP, Royal NP, Morton NP, Budderoo NP.

## *Caustis pentandra* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with short stout rhizome; stems to 60 cm high, with leaves reduced to sheaths along, and at base of stems.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Flowers in spikelets, October.
**Fruit/seed:** Nut 4–8 mm long.
**Dispersal, establishment & growth:** Diaspore: nut. No special morphology for dispersal (Westoby et al. 1990).
**Fire response:** Killed (at Leura Swamp DHB 1985), after high intensity fire 1994 (at Lane Cove and Narrabeen, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT CWS; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread
**Select locations:** **CC:** Warrah, West Head, Dural, Manly, La Perouse, Woronora River, Loftus, Waterfall, Woolwash, Bulli Pass. **CT:** Mt Baker, Glen Davis, Blackheath, Woodford.

### Habitat

**Habitat:** Ridges, rock outcrops.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Banksia ericifolia, Allocasuarina distyla, Banksia aemula;* low woodland e.g. with *Corymbia gummifera, Banksia serrata, Caustis flexuosa.*
**Substrate:** Sandy soil on sandstone, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Probably adequately conserved. Reported in Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Sydney Harbour NP, Royal NP.

## *Caustis recurvata* var. *hirsuta* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with short rhizome; stems to 70 cm high, with leaves reduced to sheaths along, and at base of stems.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Flowers in spikelets, July–September.
**Fruit/seed:** Nut 5 mm long.
**Dispersal, establishment & growth:** Diaspore: nut.
**Fire response:** Killed by fire (T. Auld pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC.
**Distribution Sydney area:** Port Jackson to Garie.
**Select locations:** CC: Centennial Park, Garie, Warumbul, Wattamolla.

### Habitat

**Habitat:** Ridges, plateaus.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Coastal heath e.g. with *Banksia serrata, Banksia ericifolia, Darwinia fascicularis, Caustis pentandra, Lambertia formosa, Allocasuarina distyla.*
**Substrate:** Sandy clay on sandstone, sometimes with ironstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Local endemic, restricted to Audley–Wattamolla, old record Centennial Park (1894) but now extinct there. Locally common in Royal NP (T. Auld pers. comm.).

## *Caustis recurvata* var. *recurvata* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with short rhizome; stems to 70 cm high, with leaves reduced to sheaths along, and at base of stems.

**Vegetative spread:**

**Longevity:**

**Primary juvenile period:**

**Flowers:** Flowers in spikelets.

**Fruit/seed:** Nut 5 mm long.

**Dispersal, establishment & growth:**

**Fire response:**

**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.

**Botanical subregions:** NC CC SC CT; Qld.

**Distribution Sydney area:** Mainly Blue Mountains.

**Select locations:** **CC:** Randwick, Ramsgate. **CT:** Currant Mountain Gap, Clarence, Blackheath.

### Habitat

**Habitat:**

**Altitude:** 0–1000 m **Annual rainfall:** 1000–1400 mm

**Typical local abundance:** Frequent.

**Vegetation:** Heath e.g. with *Allocasuarina nana, Lepidosperma flexuosum;* open-forest e.g. with *Eucalyptus sieberi, E. macrorhyncha.*

**Substrate:** Deep sandy soils on sandstone, low nutrients, well-drained.

**Exposure:**

### Conservation

**Conservation:** Most collections are from Blue Mountains area with only 3 old collections from the coast (Randwick 1884, National Park 1902, Ramsgate 1950); it may be extinct on the coast now.

## *Chorizandra cymbaria* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with tough, slender rhizome; stems to 1 m high, with basal leaves.

**Vegetative spread:**

**Longevity:** Indefinite (D. Keith pers. comm.).

**Primary juvenile period:**

**Flowers:** September–April. Flowers abundantly only after fire (Keith 1996).

**Fruit/seed:** Nut 4 mm long.

**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).

**Fire response:** Resprouts (D. Keith pers. comm.), flowering within one month in swampy area at Royal National Park (DHB 2/94), fruiting within 11 months (P. Kubiak pers. comm.).

**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.

**Botanical subregions:** NC CC SC NT CT; Qld, Vic., Tas., W.A., N Cal.

**Distribution Sydney area:**

**Select locations:** **CC:** Porters Creek, Wyong, Agnes Banks, Hornsby, Marsfield, Little Bay, Holsworthy, Bola Creek, Darkes Forest, Tahmoor, Mt Keira. **CT:** Wentworth Falls, Kangaloon, Robertson.

### Habitat

**Habitat:** Swampy places.
**Altitude:** 0–700 m **Annual rainfall:** 1000–1800 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** swamps e.g. with *Melaleuca thymifolia, Eleocharis sphacelata, Schoenus brevifolius;* heath e.g. with *Banksia ericifolia, Baeckea imbricata, Hakea teretifolia;* montane peatland e.g. with *Sphagnum, Carex, Phragmites.*
**Substrate:** Sandy to peaty alluvium, low nutrients, periodically inundated.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown. Reported in Brisbane Water NP, Garigal NP, Royal NP.

## *Chorizandra sphaerocephala* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with tough rhizome; stems to 110 cm high, with basal leaves.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** Flowers at any time, though abundantly only after fire (Keith 1996).
**Fruit/seed:** Nut 2 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.), fruiting in 8 months after high intensity fire 1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Qld, Vic.
**Distribution Sydney area:** Coast and Southern Highlands.
**Select locations:** **CC:** Manly, Centennial Park, La Perouse, Maddens Plains, Darkes Forest, Scarborough. **CT:** Hazelbrook, Hill Top, Kangaloon, Robertson, Fitzroy Falls, Budderoo.

### Habitat

**Habitat:** Swamps.
**Altitude:** 0–700 m **Annual rainfall:** 1000–1800 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedge swamp e.g. with *Gymnoschoenus sphaerocephalus, Lepidosperma limicola, Lepidosperma longitudinale;* shrub swamp e.g. with *Banksia robur, Banksia ericifolia, Hakea teretifolia.*
**Substrate:** Sandy and peaty silt, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Brisbane Water NP.

## *Cladium procerum* CYPERACEAE

### Life history

**Growth form:** Rhizomatous, perennial herb, with hollow stems to 2.5 m high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–April.
**Fruit/seed:** Nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic., S.A., N.T., N Cal.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Swansea, Pearl Beach, Webbs Creek, Oatley Bay, Kurnell, Marley Lagoon, Casula, Liverpool.

### Habitat

**Habitat:** Coastal swamps, margins of lakes.
**Altitude:** 0–20 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedge swamp e.g. with *Eleocharis sphacelata, Baumea articulata, Baumea juncea, Phragmites australis, Juncus kraussii;* edge of mangroves.
**Substrate:** Sandy to muddy alluvium, low to medium nutrients, permanently moist, often brackish.
**Exposure:**

### Conservation

**Conservation:** Not common now because of scarcity of habitat (K. Wilson pers. comm.) Conservation status unknown.

## *Cyathochaeta diandra* CYPERACEAE

### Life history

**Growth form:** Rhizomatous, tuft-forming perennial herb, with stems to 60 cm high.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** October–December. Flowers abundantly only after fire (Keith 1996).
**Fruit/seed:** Nut 7 mm long.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990). Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts e.g. at Agnes Banks (Benson 1981), secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:** Eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Qld, Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Mellong Range, Morisset, Springwood, Cowan, Cheltenham, Beacon Hill, Centennial Park, La Perouse, Campbelltown, Maddens Plains, Hill Top, Thirlmere.
**CT:** Hazelbrook.

### Habitat

**Habitat:** Ridges, sandy flats.
**Altitude:** 0–700 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Corymbia gummifera, Corymbia eximia, Angophora costata, Eucalyptus agglomerata, Angophora bakeri, Eucalyptus fibrosa, E. parramattensis;* heath e.g. with *Caustis pentandra, Ptilothrix deusta.*
**Substrate:** Sandy to loamy soils on sandstone, sometimes with lateritic influence, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Probably adequately conserved. Reported in Bouddi NP, Brisbane Water NP, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Dalrymple Hay NR, Lane Cove NP, Sydney Harbour NP.

## *Cyperus aggregatus* * *(C. flavus)* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb, with short, thick rhizome; stems to 60 cm high, leaves mostly shorter than stems.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 2 mm long, February–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America (Mexico to Argentina).
**Botanical subregions:** NC CC NWS CWS; Qld.
**Distribution Sydney area:** Mainly suburban areas.
**Select locations:** **CC:** Cheltenham (1947), Burwood, Carlton, Emu Plains, Kurnell, Linden, Camden.

### Habitat

**Habitat:** Lawns, grazed paddocks, embankments.
**Altitude:** 0–200 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassy/weedy areas e.g. with *Cyperus polystachyos, Carex appressa;* scrub e.g. with *Banksia serrata, Eucalyptus sclerophylla* (at Agnes Banks).
**Substrate:** Sandy soils on sandy alluvium, dune sand, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Weed of disturbed sites, naturalised for over 50 years.

## *Cyperus albostriatus* * CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with short thick rhizome; stems to 60 cm high, with distinctive bracts and leaves.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** October–November.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), flowering in 26 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** CC SC; Qld.
**Distribution Sydney area:**
**Select locations: CC:** Patonga (1975), Lane Cove, Mosman (1979), Centennial Park (1973), Bankstown.

### Habitat

**Habitat:** Stream banks, urban bushland.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:** Sandy soil on alluvium, sandstone, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Reported at Patonga in 1975 to be possibly persisting from old habitation but now covering considerable area and apparently spreading. Reported in bushland near gardens in Lane Cove (1987–90) spreading by rhizome. Potential for spread unknown.

## *Cyperus brevifolius* * *(Kyllinga brevifolia)* CYPERACEAE

Mullumbimy Couch

### Life history

**Growth form:** Slender perennial herb, with long slender rhizome; stems to 40 cm high, with leaves shorter than stems.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** December–March.
**Fruit/seed:** Nut 1 mm long, December–March.
**Dispersal, establishment & growth:** Dispersed in mud on cars (Wace 1977).
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove), fruiting in 10 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to tropical regions.
**Botanical subregions:** NC CC SC NWS CWS SWP; LHI, Qld, Vic., N.T., S.A., W.A.
**Distribution Sydney area:**
**Select locations: CC:** Lake Macquarie, Spencer, Beecroft, Centennial Park, Balmain, Liverpool, Macquarie Fields, Yellow Rock, Cobbitty, Kiama, Cambewarra.

### Habitat

**Habitat:** Lawns and disturbed areas, riverbanks.
**Altitude:** 0–200 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Lawns, woodland e.g. with *Rumex brownii, Geranium homeanum.*
**Substrate:** Clay soils on shale, alluvium, moist sites.
**Exposure:**

### Conservation

**Conservation:** Regarded as exotic weed in lawns and disturbed situations, though collected by Robert Brown at Port Jackson in 1802–5.

## *Cyperus compressus* * CYPERACEAE

### Life history

**Growth form:** Tufted herb, with reddish roots; stems to 35 cm high, leaves similar length to stems.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:**
**Fruit/seed:** Nut dark brown to black 1–2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to tropical and warm temperate regions.
**Botanical subregions:** NC CC; Qld, N.T., W.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Pyrmont (1973).

### Habitat

**Habitat:** Footpath.
**Altitude:** 0–50 m **Annual rainfall:** 1200 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Only one record for Sydney area. Probably not truly naturalised in the area.

## *Cyperus concinnus* CYPERACEAE

**Life history**

**Growth form:** Tufted perennial herb, with very short rhizome; stems to 65 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January.
**Fruit/seed:** Nut less than 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CT ?ST NWS CWS SWS NWP SWP NFWP; Qld, Vic., N.T.
**Distribution Sydney area:** Capertee area.
**Select locations:** CT: Capertee (1975).

**Habitat**

**Habitat:** Seasonally wet sites, creeks.
**Altitude:** 600–700 m **Annual rainfall:** 600 mm
**Typical local abundance:** Rare.
**Vegetation:**
**Substrate:** Alluvium along creeks.
**Exposure:**

**Conservation**

**Conservation:** Only one record for the area, conservation status unknown.

## *Cyperus congestus* * *(Mariscus congestus)* CYPERACEAE

Dense Flatsedge

**Life history**

**Growth form:** Tufted perennial herb, often annual, with very short thick rhizome; stems to 60 cm high, with leaves shorter or longer than stems.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut dark brown to black less than 1 mm long, May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC SC NT NWS; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Lake Macquarie, Tuggerah Lake (1903), Somersby, Dennistone, Ryde, Randwick (1884), Kurnell, Woodford, Campbelltown, Picton, Foxground.

**Habitat**

**Habitat:** Roadsides, damp ground, drains.
**Altitude:** 0–300 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Estuarine flats e.g. with *Juncus kraussii, Isolepis nodosus;* roadside vegetation e.g. with *Juncus planifolius, Cyperus flavescens.*
**Substrate:** Clayey alluvium soils, moist , sometimes brackish.
**Exposure:**

**Conservation**

**Conservation:** Naturalised for over a century, widespread.

## *Cyperus cyperoides* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with short rhizome; stems to 75 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** March.
**Fruit/seed:** Nut brown, triangular in cross section, 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NWS; Qld, N.G., Asia, Afr, ?W Indes.
**Distribution Sydney area:**
**Select locations:** **CC:** Werong Beach (1978).

### Habitat

**Habitat:** Along track.
**Altitude:** 0–50 m **Annual rainfall:** 1600 mm
**Typical local abundance:** Occasional.
**Vegetation:** Moist open-forest e.g. with *Eucalyptus botryoides.*
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Werong Beach, Royal National Park is southern geographical limit and only one record for Sydney area. Conservation status unknown.

## *Cyperus difformis* CYPERACEAE

Dirty Dora

### Life history

**Growth form:** Tufted herb, with reddish roots; stems to 50 cm high, with leaves similar in length to stems.
**Vegetative spread:**
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** April.
**Fruit/seed:** Nut triangular, less than 1 mm long, April–June.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP; Qld, Vic., N.T., S.A., W.A., pantrop.
**Distribution Sydney area:** Mainly western Sydney.
**Select locations:** **CC:** Richmond, Penrith, Doonside, Yennora, Liverpool, The Oaks, Narellan, Menangle Park. **CT:** Rylstone, Glen Davis.

### Habitat

**Habitat:** Seasonally wet places.
**Altitude:** 0–800 m **Annual rainfall:** 700–1000 mm
**Typical local abundance:** Rare–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus amplifolia, Melaleuca decora.*
**Substrate:** Clay soils on shale, alluvium.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Common in wet areas in inland Australia and in rice crops (K. Wilson pers. comm.).

## *Cyperus dubius* * CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with short rhizome; flowering stems 10–45 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Spring–summer.
**Fruit/seed:** Dark brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Africa & Asia.
**Botanical subregions:** NC CC.
**Distribution Sydney area:** Chatswood.
**Select locations:** CC: Chatswood (1996).

### Habitat

**Habitat:** Disturbed areas.
**Altitude:** 0–200 m **Annual rainfall:** 1200 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Sandy soil.
**Exposure:**

### Conservation

**Conservation:** Only one record for Sydney area, at West Chatswood in 1996. Not known whether it is naturalised there or whether it is spreading.

## *Cyperus eglobosus* CYPERACEAE

### Life history

**Growth form:** Small, tufted perennial herb, occasionally proliferating; stems to 50 cm high, with leaves shorter than stems.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut dark yellow-brown, 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld.
**Distribution Sydney area:** Coastal.
**Select locations:** CC: Budgewoi, Bass Point, Minnamurra River.

### Habitat

**Habitat:** Coastal dunes.
**Altitude:** 0–20 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Coastal dune scrub e.g. with *Leptospermum laevigatum, Guioa semiglauca, Banksia integrifolia, Acacia sophorae.*
**Substrate:** Deep sandy soil on dunes, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Localised, conservation status unknown.

## *Cyperus enervis* CYPERACEAE

### Life history

**Growth form:** Small densely tufted perennial herb; stems to 50 cm high, with leaves usually shorted than stems.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** February.
**Fruit/seed:** Nut triangular, red-brown, more than 1 mm long, April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld.
**Distribution Sydney area:** Coastal.
**Select locations: CC:** Wyong (1903), Tuggerah (1901), Werrong Beach, Balgownie.

### Habitat

**Habitat:** Near rainforest.
**Altitude:** 0–50 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Open-forest near rainforest e.g. with *Eucalyptus botryoides, E. paniculata, Livistona australis, Streblus brunonianus, Ehretia acuminata.*
**Substrate:** Clay soil on shale, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Rare, Wollongong is southern geographical limit.

## *Cyperus eragrostis* * CYPERACEAE

Umbrella Sedge

### Life history

**Growth form:** Tufted perennial to 1 m high with short thick woody rhizome; flowering stems triangular, 25–90 cm high, with leaves as long or shorter. Extensive system of coarse fibrous roots beneath perennial rootstock or rhizome, with new aerial growth produced each year (Parsons & Cuthbertson 1992).
**Vegetative spread:** No.
**Longevity:** Persistent once established (Parsons & Cuthbertson 1992).
**Primary juvenile period:**
**Flowers:** October–March (J. Hosking pers. comm.).
**Fruit/seed:** Triangular nut 1 mm long, January–March.
**Dispersal, establishment & growth:** Dispersal unspecialised, wind and water; also animal-dispersed (Carr et al. 1992), dispersed in mud on cars (Wace 1977).
Germinates and grows readily in a range of conditions.
**Fire response:** Resprouted after high intensity fire (at Lane Cove 1994), fruiting in 19 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:** Grazed sparingly by stock, competes with pasture, restricts water flow in channels and drains (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to N & S America. Introduced to Australia before 1860 (Parsons & Cuthbertson 1992).
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; LHI, Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Coast, Cumberland Plain to Mittagong, Bathurst.
**Select locations:** **CC:** Morisset, Wyong Creek, Eastwood, Northbridge (1950), Eastlakes, Birrong (1946), Windsor, Penrith, Campbelltown, Jamberoo. **CT:** Bathurst (1964), Mittagong.

### Habitat

**Habitat:** Roadside gutters and pools, rocky creeks, disturbed sandy sites.
**Altitude:** 0–800 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Seasonal and semi permanent wetland vegetation, weed dominated disturbed sites, garden weeds.
**Substrate:** Substrate alluvial silts and sands. Soil very fertile–fertile–infertile. Water table mostly high, continuous or intermittent moisture supply, fresh.
**Exposure:** Full sun.

### Conservation

**Conservation:** A potentential threat to native wetland species. First reported for the Sydney area in 1946 at Birrong this species spread vigorously in the 1960's and 70's to a range of natural and disturbed habitats. It is still spreading and probably consolidating its populations in many areas. Sites particularly at risk are seasonal and semi-permanent wetlands where it will probably outcompete and dominate smaller growing native species and change the appearance of native wetland areas.

## *Cyperus esculentus* * CYPERACEAE

Yellow Nutgrass

### Life history

**Growth form:** Perennial herb, with slender rhizomes forming yellow-rown round to ovoid tubers 10 mm diam; stems to 70 cm high, with leaves longer or shorter than stems.
**Vegetative spread:** Spread by tubers.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** February–June.
**Fruit/seed:** Nut triangular, grey-brown, less than 2 mm long. Weight 0.13 mg, germination 27% within 30 days (Shipley & Parent 1991).
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Tubers sometimes eaten as 'Chufa' or 'Tiger Nuts' (Harden 1993), cultivated and weedy forms are recognised (de Vries 1991).

### Distribution

**Status/origin:** Exotic, cosmopolitan but probably native to Meditteranean region and Africa.
**Botanical subregions:** NC CC NWS; Qld, cosmop.
**Distribution Sydney area:** Sydney suburbs, Kulnura area.
**Select locations:** **CC:** Kulnura (1988), Calga, Bayview, Terrey Hills, Northbridge (1973), East Cremorne (1984), Kurnell.

### Habitat

**Habitat:** Disturbed moist sites, roadsides.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Weedy areas e.g. with *Pennisetum clandestinum, Foeniculum vulgare, Acetosa saggitata, Bidens pilosa.*
**Substrate:** Sandy clay and alluvium, and fill, possibly in brackish conditions.
**Exposure:**

### Conservation

**Conservation:** Rarely naturalised but a serious weed of tropical and subtropical cultivation in other parts of the world. Tubers are spread by farm machinery. Potential to spread in Sydney area is unknown.

## *Cyperus exaltatus* CYPERACEAE

### Life history

**Growth form:** Stout, tussock-forming perennial herb, with short woody rhizome; stems triangular, to 1.8 m high, with leaves at least as long as stems.
**Vegetative spread:** Rhizomatous spread to form extensive stands.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut triangular, yellow-brown, less than 1 mm long, February–March.
**Dispersal, establishment & growth:** Appears to be a coloniser species but does not appear to establish readily from seed. Forms narrow zone around edge of Longneck Lagoon in permanent water 10–20 cm deep but does not extend beyond margin.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., N.T., S.A., W.A., Africa, Asia, ? S. America.
**Distribution Sydney area:** Hawkesbury–Nepean floodplain wetlands.
**Select locations:** **CC:** Longneck Lagoon, South Creek (1888), St Marys, Regentville, Werrington. **CT:** Ophir.

### Habitat

**Habitat:** Banks of streams and lagoons, shallow water.
**Altitude:** 0–800 m **Annual rainfall:** 700–800 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Semi-permanent, emergent wetland vegetation.
**Substrate:** Alluvial silts and sand, medium to high nutrients, permanently wet.
**Exposure:** Full sun.

### Conservation

**Conservation:** Recorded from a few Hawkesbury wetland areas only, with a recent (1994) record from Orange.

## *Cyperus flaccidus* CYPERACEAE

### Life history

**Growth form:** Small tufted annual herb, with stems 2–20 cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** February–April.
**Fruit/seed:** Nut 0.5 mm long, January–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT NWP SWP; Qld, Vic., N.T., S.A., W.A., Japan, Korea.
**Distribution Sydney area:** Western Sydney.
**Select locations:** CC: Lower Portland, Richmond, Woodford, Valley Heights, Doonside, Ingleburn, The Oaks, Campbelltown, Menangle Park.

### Habitat

**Habitat:** Wet places, damp depressions, margins of ephemeral pools.
**Altitude:** 0–550 m **Annual rainfall:** 700–1000 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Juncus usitatus, Cyperus sanguinolentus, Eleocharis stricta, Paspalum distichum, Myriophyllum latifolium.*
**Substrate:** Drying mud and silt, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown. Common annual in tropical Australia (K. Wilson pers. comm.).

## *Cyperus flavescens* * (*Pycreus flavescens*) CYPERACEAE

### Life history

**Growth form:** Tufted annual, with stems 5–30 cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:**
**Fruit/seed:** Dark brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to temperate & tropical regions.
**Botanical subregions:** NC CC NT NWS; Qld, N.T.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Howes Valley (1994), Morisset (1993), Somersby (1974), Manly Dam (1988), Bulli Pass (1995).

### Habitat

**Habitat:** Disturbed, damp situations, creeks.
**Altitude:** 0–400 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Moist disturbed sites e.g. with *Juncus articulatus, Juncus planifolius* and introduced grasses and sedges.
**Substrate:** Sandy soil, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Recently recorded (1974), ability to spread unknown.

## *Cyperus flavidus* (*Pycreus flavidus*) CYPERACEAE

### Life history

**Growth form:** Tufted annual or perennial herb, with smooth stems 5–60 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–April.
**Fruit/seed:** Nut 1.2 mm long, dark brown to black.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CT ST NWS SWS; Qld, Vic., Old World, trop, subtrop.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Brooklyn, Regentville. **CT:** Nashdale, Mt Canobolas.

### Habitat

**Habitat:** Swampy areas, riverbanks, roadside drains.
**Altitude:** 0–800 m **Annual rainfall:** 800–1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** With *Eleocharis gracilis, Juncus fockei, Geranium solanderi, Eucalyptus bridgesiana.*
**Substrate:** Clay soil, moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Cyperus fulvus* (*Mariscus fulvus*) CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb, with stems 25–50 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January.
**Fruit/seed:** Yellow-brown nut 2 mm long, March–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT NWS CWS NWP SWP NFWP; Qld, Vic., N.G.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Mt Wareng, Agnes Banks, Casula, Menangle, Goodmans Ford. **CT:** Currant Mountain Gap, Jenolan Caves.

### Habitat

**Habitat:** Open slopes, hillsides.
**Altitude:** 0–900 m **Annual rainfall:** 800–1000 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassy woodland e.g. with *Eucalyptus botryoides, E. tereticornis, E. albens, Allocasuarina verticillata, Pteridium esculentum.*
**Substrate:** Sandy to stony clay soil on shale, basalt, alluvium, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Cyperus gracilis* CYPERACEAE

### Life history

**Growth form:** Small, densely tufted perennial herb; flowering stems 10–40 cm high, with very narrow, shorter leaves.

**Vegetative spread:** No (McIntyre et al. 1995).

**Longevity:** Less than 5 years.

**Primary juvenile period:** Less than 1 year.

**Flowers:** September–December.

**Fruit/seed:** Triangular nut, January–April.

**Dispersal, establishment & growth:** Means of dispersal undefined (McIntyre et al. 1995).

**Fire response:**

**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.

**Botanical subregions:** NC CC SC NT CT NWS CWS NWP SWP; Qld, Vic., N.I., N. Cal.

**Distribution Sydney area:** Widespread.

**Select locations:** **CC:** Howes Valley, Lower Portland, Eastwood, Willoughby, Bankstown, Bass Hill, Blackett, Nortons Basin, Razorback, Mount Annan, Stanwell Park. **CT:** Capertee Valley, Glen Davis, Kowmung River, Mittagong.

### Habitat

**Habitat:** Hillsides, flats.

**Altitude:** 0–600 m **Annual rainfall:** 700–1200 mm

**Typical local abundance:** Frequent.

**Vegetation:** Open woodland e.g. with *Eucalyptus moluccana, E. tereticornis, E. albens, E. melliodora, E. amplifolia, Angophora floribunda;* grassland.

**Substrate:** Clay soil on shale, volcanics, metasediments, medium to high nutrients

**Exposure:**

### Conservation

**Conservation:** Conserved in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Cyperus gunnii* subsp. *gunnii* (*Mariscus gunnii*) CYPERACEAE

### Life history

**Growth form:** Tall, tufted perennial herb with short thick rhizome. Culms to 150 cm high.

**Vegetative spread:**

**Longevity:**

**Primary juvenile period:**

**Flowers:** October–December.

**Fruit/seed:** Triangular nut.

**Dispersal, establishment & growth:**

**Fire response:**

**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.

**Botanical subregions:** NC CC SC NT ST NWS CWS SWS NWP SWP ?SFWP; Qld, Vic., Tas., S.A.

**Distribution Sydney area:** Western Sydney.

**Select locations:** **CC:** Doonside, Como, Minto, Casula, Campbelltown, Menangle.

### Habitat

**Habitat:** Swamp margins, creeks.

**Altitude:** 0–200 m **Annual rainfall:** 700–1000 mm

**Typical local abundance:** Occasional.

**Vegetation:** Margin of swamps e.g. with *Carex appressa, Glyceria australis, Ranunculus inundatus, Triglochin procera;* woodland e.g. with *Eucalyptus amplifolia, E. tereticornis, Casuarina glauca.*

**Substrate:** Clay soil on shale, alluvium, medium nutrients, periodically wet.

**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999).

## *Cyperus gymnocaulos* CYPERACEAE

### Life history

**Growth form:** Tussock-forming perennial herb, with short thick rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic in CC but native to other parts of Australia, introduced to Sydney area from western NSW.
**Botanical subregions:** *CC SWS NWP SWP NFWP SFWP; Qld, Vic., N.T., S.A., W.A.
**Distribution Sydney area:** Flemington.
**Select locations:** CC: Flemington (1968).

### Habitat

**Habitat:** Saleyards.
**Altitude:** 0–100 m **Annual rainfall:** 900 mm
**Typical local abundance:** Rare.
**Vegetation:** Disturbed sites.
**Substrate:** Clay soils.
**Exposure:**

### Conservation

**Conservation:** Only record for Sydney is for single isolated clump at Flemington Saleyards in 1968 and the species is likely to have been introduced from western NSW with stock. It is now probably extinct at Flemington.

## *Cyperus haspan* subsp. *haspan* CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb to 40 cm high, with short rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–June.
**Fruit/seed:** Whitish to pale yellow-brown nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NWP; Qld.
**Distribution Sydney area:** Mainly Western Sydney.
**Select locations:** CC: Wyong, Bowen Mountain, Agnes Banks, Londonderry, Bayview, Prestons, Chatham Village.

### Habitat

**Habitat:** Moist, disturbed sites.
**Altitude:** 0–400 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Woodland e.g. with *Angophora bakeri, Eucalyptus parramattensis, E. sclerophylla;* open-forest e.g. with *Corymbia gummifera, Eucalyptus piperita, Angophora costata;* swamp e.g. with *Melaleuca quinquenervia.*
**Substrate:** Clay soils on shale, Tertiary alluvium, sandy alluvium, low nutrients, periodically wet.
**Exposure:**

### Conservation

**Conservation:** Chatham Village–Prestons is southern geographical limit. Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Cyperus imbecillis* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** December–May.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CWS; Qld.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Drews Creek, Bilpin, Wahroonga, Dennistone, Lane Cove, Bankstown, Bola Creek, Stanwell Park, Razorback, Foxground, Bass Point, Berry.

### Habitat

**Habitat:** Moist, shady areas.
**Altitude:** 0–300 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Rainforest e.g. with *Streblus brunonianus, Cassine australis;* open-forest e.g. with *Eucalyptus saligna, E. pilularis.*
**Substrate:** Clay soil on shale, basalt, medium to high nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Reported in Yengo NP, Royal NP.

## *Cyperus involucratus* * (*C. alternifolius* subsp. *flabelliformis)* CYPERACEAE

Umbrella Sedge

### Life history

**Growth form:** Tall herb, with leaves reduced to sheaths; inflorescence large, with numerous conspicuous bracts.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:**
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Africa. Introduced as ornamental.
**Botanical subregions:** CC; LHI, Qld, N.T., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Parsley Bay (1990), Dawes Point (1996).

### Habitat

**Habitat:** Near creek.
**Altitude:** 0–200 m **Annual rainfall:** 1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Disturbed bush.
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Widely cultivated, with a couple of records in disturbed bushland near urban areas. Problem weed in New Caledonia, with potential to spread from Sydney, north along the coast (K. Wilson pers. comm.).

## *Cyperus iria* CYPERACEAE

Rice Flatsedge

### Life history

**Growth form:** Tufted annual herb, with reddish roots.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:**
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic in CC but native to more northern and inland parts of Australia.
**Botanical subregions:** NC *CC NWP SWP NFWP; Qld, N.T., S.A., W.A., Malesia, Asia, Afr.
**Distribution Sydney area:** Liverpool.
**Select locations:** CC: Warwick Farm (1993).

### Habitat

**Habitat:** Creeks.
**Altitude:** 0–100 m **Annual rainfall:** 800 mm
**Typical local abundance:** Rare.
**Vegetation:** Low open-forest e.g. *Casuarina glauca* with understorey including *Carex appressa.*
**Substrate:** Sandy clay soil on alluvium, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Only one record of one plant, recorded for Cabramatta Creek in 1993 and regarded as introduced.

## *Cyperus laevigatus* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with long thick rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–May.
**Fruit/seed:** Dark yellow-brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NWP NFWP; Qld, Vic., N.T., S.A., W.A., Asia, Afr., Eur., Amer.
**Distribution Sydney area:** Coastal estuaries.
**Select locations:** CC: Narrabeen, Curl Curl, Woolooware Bay, Kurnell, Port Hacking, Stanwell Park, Lake Illawarra, Shoalhaven River.

### Habitat

**Habitat:** Foreshores, behind mangroves, lagoons.
**Altitude:** 0–150 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–rare.
**Vegetation:** Saltmarsh e.g. with *Juncus kraussii, Samolus repens;* brackish swamp margins e.g. with *Isolepis nodosa, I. cernua.*
**Substrate:** Intertidal mudflats, sandy alluvium, medium nutrients, periodically flooded, saline–brackish.
**Exposure:**

### Conservation

**Conservation:** Threatened because of habitat degradation (K. Wilson pers. comm.).

## *Cyperus laevis* CYPERACEAE

### Life history

**Growth form:** Small, tufted perennial herb, sometimes proliferating; culms 15–55 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–July, peak March.
**Fruit/seed:** Dark red-brown nut 1 mm long, November–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CWS; Qld.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Wondabyne, Barrenjoey, Hornsby, Beecroft, Towra Point, Bankstown, Nortons Basin, Hayes Crossing, Elderslie, Woronora River, Stanwell Park, Minnamurra, Mt Coolangatta.

### Habitat

**Habitat:** Hillsides.
**Altitude:** 0–200 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus saligna, Angophora floribunda, Corymbia maculata, E. tereticornis;* dry rainforest e.g. with *Cassine australis, Streblus brunonianus, Diospyros australis.*
**Substrate:** Clay soils on shale, volcanic necks, latite, alluvium, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Reported in Blue Mountains NP, Brisbane Water NP, Dharug NP, Ku-ring-gai Chase NP, Sydney Harbour NP, Royal NP.

## *Cyperus leiocaulon* (*Mariscus laevis*) CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with stems swollen at base, 20–40 cm high and very short thick rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Brown to blackish nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NWS NWP; Qld.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Wisemans Ferry, Woy Woy, Agnes Banks, Auburn, Casula, Elderslie, Menangle Park.

### Habitat

**Habitat:** Sand deposits, beaches, riverflats.
**Altitude:** 0–100 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Occasional–frequent.
**Vegetation:** Open-forest e.g. with *Eucalyptus botryoides, Banksia serrata, Eucalyptus sclerophylla, E. fibrosa, Melaleuca decora.*
**Substrate:** Sandy, less commonly clayey soil, on dunes, alluvium, shale.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere not known.

## *Cyperus lhotskyanus* CYPERACEAE

### Life history

**Growth form:** Slender perennial herb, with stems 20–60 cm high and longish rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Yellow-brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST NWS CWS SWS NWP SWP; Vic., S.A.
**Distribution Sydney area:** Tablelands.
**Select locations:** **CC:** Newnes. **CT:** Kelso, Bathurst, Orange, Bullio.

### Habitat

**Habitat:** Stream banks, floodways.
**Altitude:** 500–800 m **Annual rainfall:** 700–900 mm
**Typical local abundance:** Rare.
**Vegetation:** Creekbank vegetation e.g. with *Juncus subglaucus, Schoenus validus;* swamp e.g. with *Cyperus sphaeroideus.*
**Substrate:** Sandy soils on alluvium, granite, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Cyperus lucidus* CYPERACEAE

### Life history

**Growth form:** Robust, tussock-forming perennial herb, with stems 30–150 cm high and short thick rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–January.
**Fruit/seed:** Dark grey-brown to blackish nut 3 mm long, December–January.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP; LHI, Qld, Vic., Tas., S.A., W.A., N.I., N.G.
**Distribution Sydney area:**
**Select locations:** **CC:** Morisset, Putty, Kurrajong, Centennial Park, Milperra, Menangle, Douglas Park. **CT:** Rylstone, Colong Swamp, Morgan Swamp (Avon Dam), Mittagong, Long Swamp (Kodela 1992).

### Habitat

**Habitat:** Swampy areas, stream banks.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus elata, Melaleuca linariifolia, Carex longibracteata, Viola hederacea, Dichondra repens.*
**Substrate:** Sandy to loamy alluvium, low to medium nutrients, periodically inundated.
**Exposure:**

### Conservation

**Conservation:** Many old records, fewer recent ones. Vulnerable in Western Sydney (James et al. 1999). Vulnerable because of habitat changes in swampy coastal areas (K. Wison pers. comm.).

## *Cyperus mirus* CYPERACEAE

### Life history

**Growth form:** Small, densely tufted perennial herb, with stems to 50 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Black, cross-barred, striate nut is different from other nuts in Cyperus, January–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld.
**Distribution Sydney area:** Suburban areas.
**Select locations:** **CC:** Mt Colah, Roseville, RBG (1966), Domain (1903), Emu Plains, Strathfield, Sutherland.

### Habitat

**Habitat:** Moist shady places.
**Altitude:** 0–100 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Riverflat forest, lawns.
**Substrate:** Clay soils on shale, alluvium, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Recorded in lawns and gardens, conservation status unknown.

## *Cyperus odoratus* CYPERACEAE

### Life history

**Growth form:** Tufted annual or perennial herb, with stems 20–120 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** February–May.
**Fruit/seed:** Brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, pantrop regions.
**Distribution Sydney area:** Wyong area, Nowra.
**Select locations:** **CC:** Wollombi, Lake Munmorah, Wyong, Coomonderry Swamp.

### Habitat

**Habitat:** Creek banks, swamp margins.
**Altitude:** 0–50 m **Annual rainfall:** 1000–1200 mm
**Typical local abundance:** Frequent–rare.
**Vegetation:** Swamp margins and floating islands e.g. with *Typha orientalis, Persicaria lapathifolia, Carex appressa, Schoenoplectus mucronatus, Melaleuca decora.*
**Substrate:** Clay soils on alluvium, medium nutrients, periodically wet, fresh.
**Exposure:**

### Conservation

**Conservation:** Rare, Coomonderrry Swamp is southern geographical limit.

## *Cyperus polystachyos* (*Pycreus polystachyos*) CYPERACEAE

### Life history

**Growth form:** Tufted annual or perennial, with short rhizome; stems 10–60 cm high, with leaves shorter.
**Vegetative spread:**
**Longevity:** Probably short-lived, less than 5 years.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Red-brown to blackish nut 1 mm long, January–March.
**Dispersal, establishment & growth:**
**Fire response:** Possibly resprouted after high intensity fire 1994 (at Lane Cove), flowering in 10 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native. Possibly introduced in Sydney region (K. Wilson pers. comm.).
**Botanical subregions:** NC CC SC NWS CWS; LHI, Qld, Vic., N.T., W.A., pantrop.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Wyong, Lower Portland, Agnes Banks, Barrenjoey, Towlers Bay, Cheltenham, Manly, Nielsen Park, Centennial Park, Cooks River, Towra Point, La Perouse, Kurnell, Woronora River, Lake Illawarra, Berry.

### Habitat

**Habitat:** Wetlands, headlands, roadsides.
**Altitude:** 0–200 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Various; headland grassland e.g. with *Themeda australis;* wet places e.g. with *Juncus articulatus, Cyperus congestus, Isolepis nodosa.*
**Substrate:** Clayey to sandy soil on alluvium, shale, dune sand, medium nutrients, permanently moist, sometimes brackish.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Reported in Sydney Harbour NP.

## *Cyperus procerus* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with long rhizome; stems 70–120 cm high.
**Vegetative spread:** Yes, spreading rhizomes initiate new plants.
**Longevity:**
**Primary juvenile period:**
**Flowers:** March–April.
**Fruit/seed:** Blackish brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, N.T., Asia.
**Distribution Sydney area:** St Marys.
**Select locations: CC:** St Marys (1990), Ropes Creek (1992).

### Habitat

**Habitat:** Swamps.
**Altitude:** 0–50 m **Annual rainfall:** 800 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swamp e.g. with *Eleocharis pusilla, E. sphacelata, Schoenoplectus validus, Nymphoides geminata.*
**Substrate:** Clay soil on alluvium, with periodically standing water, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Rare in Sydney area (Harden 1993). Outlier population and southern geographical limit is St Marys. Vulnerable in Western Sydney (James et al. 1999).

## *Cyperus reflexus* * CYPERACEAE

Flatsedge

### Life history

**Growth form:** Slender perennial herb, with short thick rhizome; stems 20–50 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–March.
**Fruit/seed:** Grey-brown nut 1 mm long, November–March.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to N and S America.
**Botanical subregions:** CC CT; Vic.
**Distribution Sydney area:** Sydney suburban areas.
**Select locations:** **CC:** Annangrove, St Ives, Oxford Falls, North Ryde, Rooty Hill, Picnic Point, Parramatta (1959), **CT:** Woodford (1974, 1976, 1999).

### Habitat

**Habitat:** Margins of bushland, disturbed sites, drains.
**Altitude:** 0–500 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Roadside vegetation e.g. with *Paspalum dilatatum, Coreopsis lanceolata, Conyza albida.*
**Substrate:** Sandy to clay soils on alluvium, periodically moist, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Extent of potential spread unknown.

## *Cyperus rigens* * CYPERACEAE

### Life history

**Growth form:** Perennial herb, with short thick rhizome; stems 50–100 cm high.
**Vegetative spread:** Probably by rhizomes (K. Wilson pers. comm.).
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Dark red-brown nut 1 mm long, March–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America.
**Botanical subregions:** CC CT.
**Distribution Sydney area:** Blue Mountains.
**Select locations:** **CC:** Glenbrook (1973). **CT:** Blackheath, Lawson (1967), Wentworth Falls (1972), Woodford (1972).

### Habitat

**Habitat:** Roadsides, gutters.
**Altitude:** 200–1000 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** e.g. with *Cyperus reflexus, C. congestus, C. eragrostis, Juncus continuus, J. planifolius.*
**Substrate:** Sandy soils, moist.
**Exposure:**

### Conservation

**Conservation:** Naturalised in Blue Mountains since 1960s, rate of spread unknown.

## *Cyperus rotundus* * **CYPERACEAE**

Nutgrass

### Life history

**Growth form:** Perennial herb, with stems 15–60 cm high; rhizomes form egg-shaped tubers 5–10 mm diam.

Deep extensive root system of roots, rhizomes, tubers and basal bulbs; chains of up to 15 tubers, but growth from one tuber in the chain inhibits growth from others (Parsons & Cuthbertson 1992).

**Vegetative spread:** Growth of rhizome and tuber extends boundary of patch by more than 1 metre per year (Parsons & Cuthbertson 1992).

**Longevity:** Indefinite.

**Primary juvenile period:**

**Flowers:** January–June, peak March.

**Fruit/seed:** Dark grey-brown nut 1 mm long. Very little viable seed produced, germinates poorly and very few seedlings survive (Parsons & Cuthbertson 1992).

**Dispersal, establishment & growth:** Mainly vegetative spread by tubers; 6–10 buds on each tuber, each of which may produce a new plant when tuber is detached e.g. by cultivation (Parsons & Cuthbertson 1992). Dispersed by flood waters, in potted plants (J. Hosking pers. comm.) and in mud on cars (Wace 1977). Photosynthetic pathway C4, giving it a competitive advantage over many other plants (Parsons & Cuthbertson 1992).

**Fire response:**

**Interaction with other organisms:** Allelopathic, with exudate from roots and leachate from dried plants inhibiting growth of other plants; important use in Indian and Chinese medicine; tubers consumed by Aborignial people in northen and central Australia (Parsons & Cuthbertson 1992), used by American Indians as cereal (Murphy 1990).

### Distribution

**Status/origin:** Exotic, now pantropical, possibly native to Asia., although exact native range is obscure (J. Hosking pers. comm.).

**Botanical subregions:** NC CC SC ST NWS CWS SWS NWP; LHI, Qld, Vic., N.T., S.A., W.A.

**Distribution Sydney area:** Suburban areas.

**Select locations:** **CC:** Richmond (1923), Dural, Willoughby, Rose Bay (1894), Centennial Park (1899), Annandale, Kogarah (1901), Menangle, Bomaderry.

### Habitat

**Habitat:** Disturbed areas around habitation, paddocks, wet places.

**Altitude:** 0–200 m **Annual rainfall:** 800–1400 mm

**Typical local abundance:** Frequent–occasional.

**Vegetation:** Disturbed sites e.g. with *Cyperus laevis, C. polystachyos*, garden weeds.

**Substrate:** Sandy to clay soils. Susceptible to flooding (Parsons & Cuthbertson 1992).

**Exposure:** Can withstand conditions of high temperature and low light (Parsons & Cuthbertson 1992).

### Conservation

**Conservation:** Weed in disturbed situations, cultivated paddocks, gardens, naturalised for over a century.

## *Cyperus sanguinolentus* (*Pycreus sanguinolentus*) CYPERACEAE

### Life history

**Growth form:** Tufted annual or perennial herb, with stems 5–80 cm high, leaves equal or shorter.
**Vegetative spread:**
**Longevity:** Annual or perennial.
**Primary juvenile period:**
**Flowers:** April.
**Fruit/seed:** Brown to blackish nut 1 mm long.
**Dispersal, establishment & growth:** Dispersed in mud on cars (Wace 1977). Germination in all seasons in Northern Tablelands (Britton & Brock 1994).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., ?N.T., S.A., W.A., Malesia, Asia, Africa.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wyong, Springwood, Byrnes Gap, Kowmung River, Cheltenham, Doonside, Orchard Hills, Centennial Park, Parramatta, Kogarah, Nortons Basin, Waterfall, Berry. **CT:** Orange, Clarence, Blackheath, Leura, Kangaloon, Bundanoon.

### Habitat

**Habitat:** Swamps, stream banks, roadsides.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Eleocharis acuta, Philydrum lanuginosum;* roadside ditches e.g. with *Cyperus eragrostis, C. difformis;* riverflat forest e.g. with *Casuarina glauca, E. tereticornis, Angophora subvelutina.*
**Substrate:** Clay to silty soils on alluvium, medium nutrients, moist. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Cyperus sesquiflorus* * (*Kyllinga odorata*) CYPERACEAE

Kyllinga Weed

### Life history

**Growth form:** Annual or perennial herb, with short rhizome; stems 5–40 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–May.
**Fruit/seed:** Black nut 1 mm long, November–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Exotic, native to tropical regions.
**Botanical subregions:** NC CC NT; Qld, N.T.
**Distribution Sydney area:** Mainly Sydney suburban area.
**Select locations:** **CC:** Mellong Range, Wisemans Ferry (1908), Linden, Cheltenham, Mosman Bay (1884), Centennial Park (1897), Cooks River (1911), Casula, Waterfall.

### Habitat

**Habitat:** Pastures, lawns, disturbed sites.
**Altitude:** 0–500 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** e.g. with *Cyperus flaccidus, C. sanguinolentus, Fimbristylis dichotoma, Paspalum dilatatum, Bidens pilosa.*
**Substrate:** Sandy soil, often damp.
**Exposure:**

### Conservation

**Conservation:** Naturalised for over a century.

## *Cyperus sphaeroideus* *(Kyllinga intermedia)* CYPERACEAE

### Life history

**Growth form:** Slender perennial herb, with long slender rhizome; stems triangular to 50 cm high.
**Vegetative spread:** Yes (McIntyre et al. 1995), creeping rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** January–April, peak March.
**Fruit/seed:** Pale brown nut 1 mm long.
**Dispersal, establishment & growth:** Means of dispersal undefined (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS; Qld, Vic.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Wisemans Ferry. **CT:** Currant Mountain Gap, Molong Creek, Lidsdale, Wyagden, Wingecarribee Swamp, Joadja, Bundanoon.

### Habitat

**Habitat:** Creekbanks, wet places.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Swamp margins e.g. with *Schoenus apogon, Juncus fockei.*
**Substrate:** Peaty soils on alluvium, granite, low nutrients, periodically moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Cyperus tenellus* * CYPERACEAE

Tiny Flatsedge

### Life history

**Growth form:** Dwarf tufted annual herb, with stems 1–8 cm high; thread-like leaves shorter than stems.
**Vegetative spread:** No.
**Longevity:** Less than a year.
**Primary juvenile period:** Less than a year.
**Flowers:**
**Fruit/seed:** Brown nut 1 mm long, October–November.
**Dispersal, establishment & growth:** Animal, water, and possibly wind-dispersed (Carr et al. 1992).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC SC CT SWS SWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Mainly Sydney suburban area.
**Select locations:** **CC:** Wyong Creek, Narrabeen, Parramatta (1900), Gladesville (1914), Centennial Park (1900), Cooks River (1909), Kogarah (1893), Glenfield, Waterfall, Menangle Park. **CT:** Megalong Valley.

### Habitat

**Habitat:** Damp, disturbed areas.
**Altitude:** 0–700 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus parramattensis, Melaleuca decora;* heath e.g. with *Acacia sophorae, Melaleuca nodosa, Banksia ericifolia;* grassland.
**Substrate:** Sandy to silty soil on alluvium, sandstone. Moist sites (J. Hosking pers. comm.).
**Exposure:**

### Conservation

**Conservation:** Naturalised near habitation for over a century.

## *Cyperus teneristolon* * CYPERACEAE

### Life history

**Growth form:** Herb with stems to 80 cm high (J. Hosking pers. comm.).
**Vegetative spread:** By stolons and rhizomes.
**Longevity:**
**Primary juvenile period:**
**Flowers:** March.
**Fruit/seed:**
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to eastern and southern Africa.
**Botanical subregions:** CT.
**Distribution Sydney area:** Katoomba.
**Select locations:** **CT:** Minnehaha Falls (2000), Yosemite Creek (2001).

### Habitat

**Habitat:** Picnic area.
**Altitude:** 1000 m **Annual rainfall:** 1400 mm
**Typical local abundance:** Frequent.
**Vegetation:**
**Substrate:** Sandy soil over sandstone, moist areas (J. Hosking pers. comm.).
**Exposure:**

### Conservation

**Conservation:** Recently recorded as locally established at Katoomba from Blue Mountains Refuse Tip, downstream along Yosemite Creek for a few kilometres (J. Hosking pers. comm.).

## *Cyperus tetraphyllus* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with short rhizome; stems to 50 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Spikelets dark brown to black, March.
**Fruit/seed:** Yellowish nut 1 mm long.
**Dispersal, establishment & growth:** Diaspore: nut, no special morphology for dispersal (Westoby et al. 1990).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CWS; Qld.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Wahroonga, Eastwood, Lilyvale, Belambi Creek, Austinmer, Albion Park, Minnamurra Falls, Kangaroo Valley, Mt Coolangatta,.

### Habitat

**Habitat:** Creekbanks.
**Altitude:** 0–300 m **Annual rainfall:** 1200–1600 mm
**Typical local abundance:** Occasional.
**Vegetation:** Rainforest e.g. with *Streblus brunonianus, Cassine australis, Diospyros australis;* moist eucalypt forest e.g. with *Eucalyptus pilularis, E. quadrangulata, Syncarpia glomulifera.*
**Substrate:** Clay soils on shale, alluvium, medium–high nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Cyperus trinervis* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb, with stems and leaves 15–50 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** December–May, peak March.
**Fruit/seed:** Dark brown nut 1 mm long, December–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT NWS; Qld.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Glenbrook, Eastwood, Doonside, Fairfield, Ingleburn, Port Hacking, Douglas Park, Albion Park, Kiama.

### Habitat

**Habitat:** Creekbanks.
**Altitude:** 0–200 m **Annual rainfall:** 800–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Rainforest, riparian forest.
**Substrate:** Sandy soil on alluvium, volcanic necks, moist, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999).

## *Cyperus vaginatus* CYPERACEAE

### Life history

**Growth form:** Tussock-forming perennial herb, occasionally proliferating, with short, thick rhizome; stems to 100 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Grey-brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT NWS CWS NWP; Qld, Vic., N.T., S.A., W.A.
**Distribution Sydney area:** Capertee Valley.
**Select locations:** CC: Crown Creek (1966).

### Habitat

**Habitat:** Along creeks.
**Altitude:** 100–300 m **Annual rainfall:** 600 mm
**Typical local abundance:** Rare.
**Vegetation:**
**Substrate:** Rocky creekbank. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Rare, only one recent record from Capertee Valley, at Crown Creek in 1966.

## *Cyperus vorsteri* * CYPERACEAE

### Life history

**Growth form:** Robust tufted perennial herb, with short thick rhizome; stems 50–150 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Dark yellow-brown nut 2 mm long.
**Dispersal, establishment & growth:** Diaspore: seed.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC; W.A.
**Distribution Sydney area:** Sydney suburbs.
**Select locations:** CC: Marramarra Creek (1998), Dee Why (2000), Mosman (1994), Parsley Bay (1995), Lugarno (1995).

### Habitat

**Habitat:** Disturbed areas, suburban parks, drains.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Woodland e.g. with *Angophora costata, Angophora floribunda, Eucalyptus pilularis.*
**Substrate:** Sandy soils on sandstone, alluvium, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Apparently recently naturalised and spreading in suburban bushland e.g. at Mosman.

## *Eleocharis acuta* CYPERACEAE

### Life history

**Growth form:** Perennial herb; stems usually 10–60 cm high, produced along a linear rhizome but occasionally tufted (Sainty & Jacobs 1981).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–March.
**Fruit/seed:** Yellow to brown nut 2 mm long.
**Dispersal, establishment & growth:** Germination in all seasons in Northern Tablelands (Britton & Brock 1994).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., N.T. S.A. W.A., N.Z., N.G.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Centennial Park, Oatley, Casula, Menangle Park, Coomonderry Swamp. **CT:** Rylstone, Mt Canobolas, Clarence, Hartley, Bowral, Taralga.

### Habitat

**Habitat:** Margins of swamps, depressions.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Rare–occasional.
**Vegetation:** Swamp margins e.g. with *Eleocharis minuta, Ranunculus inundata.*
**Substrate:** Sandy alluvium, low nutrients, permanently wet. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Conservation status not known.

## *Eleocharis atricha* CYPERACEAE

### Life history

**Growth form:** Slender tufted perennial herb, with stems 3–40 cm high and slender rhizomes bearing tubers.
**Vegetative spread:** Probably rhizomatous spread.
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–May.
**Fruit/seed:** Straw-coloured nut 1 mm long, though spikelets frequently fail to develop fruit (Herb. note).
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT CT ST SWS; Qld, Vic., N.T., S.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Moorebank, Glenfield, Menangle Park, Thirlmere. **CT:** Mt Canobolas, Hill Top, Moss Vale, Penrose.

### Habitat

**Habitat:** Moist situations, permanent and ephemeral swamps, drainage lines.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1000 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Lepyrodia anarthria, Gonocarpus micranthus, Baumea rubiginosa;* scrub e.g. with *Melaleuca nodosa, Melaleuca decora;* woodland e.g. with *Eucalyptus dalrympleana, E. bridgesiana.*
**Substrate:** Sandy clay loam on sediments, shales, low to medium nutrients, moist, periodically inundated.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Eleocharis cylindrostachys* CYPERACEAE

### Life history

**Growth form:** Perennial herb with very short rhizome; flowering stems 30–50 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–April.
**Fruit/seed:** Biconvex nut, February–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT NWS NWP; Qld.
**Distribution Sydney area:** Mainly Western Sydney.
**Select locations:** **CC:** Martinsville, St Marys, Toongabbie, Orchard Hills, Doonside, Glenfield, Mount Annan, Wedderburn.

**Habitat**

**Habitat:** Moist places, margins of wetland, ponds, creeks.
**Altitude:** 0–200 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Swamp woodland e.g. with *Melaleuca decora, Casuarina glauca, Eucalyptus tereticornis;* segeland e.g. with *Schoenoplectus mucronatus, Isolepis inundata.*
**Substrate:** Clay soils on shale, Tertiary alluvium, medium nutrients, permanently moist, periodically inundated.
**Exposure:**

**Conservation**

**Conservation:** Wedderburn is southern geographical limit. Vulnerable in Western Sydney (James et al. 1999).

## *Eleocharis dietrichiana* CYPERACEAE

**Life history**

**Growth form:** Slender perennial herb with short rhizome; stems to 30 cm high with partial transverse septa.
**Vegetative spread:** By rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** September–March.
**Fruit/seed:** Brown nut 1 mm long, seeds 1 mm long, March.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CC NT; Qld.
**Distribution Sydney area:** Mainly western Sydney.
**Select locations:** CC: Wyong, Doonside, Penrith, Glenbrook Lagoon, Centennial Park, Liverpool, Glenfield, Narellan.

**Habitat**

**Habitat:** Wetland margins, ephemeral creeks.
**Altitude:** 0–100 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Sedgeland e.g. *Paspalum distichum, Marsilea mutica, Carex appressa, Eleocharis* species.
**Substrate:** Clay soils on alluvium, medium nutrients, water table mostly high, moisture supply intermittent, fresh.
**Exposure:** Full sun.

**Conservation**

**Conservation:** Narellan is southern geographical limit. Vulnerable in Western Sydney (James et al. 1999).

## *Eleocharis equisetina* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb with slender rhizomes; stems terete, to 1 m high, transversely septate.
**Vegetative spread:** Stoloniferous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** July–December.
**Fruit/seed:** Nut 2 mm long, December–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Foodplant of Pacific Black Duck *Anas superciliosa*, seed eaten by Plumed Whistling Duck *Dendrocygna etoni* (Barker & Vestjens 1989,1990). Forms part of habitat for waterfowl (Sainty & Jacobs 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Malesia, Asia, Madagascar.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Wyong, Lower Portland, Mulgoa, Berry.

### Habitat

**Habitat:** Swamps, lagoons in water to 0.5 m deep (Sainty & Jacobs 1981).
**Altitude:** 0–100 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Estuarine wetland e.g. with *Melaleuca quinquenervia, Casuarina glauca, Eleocharis sphacelata, Juncus usitatus.*
**Substrate:** Clay soils on alluvium, medium nutrients, water table mostly high, brackish–fresh.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Eleocharis gracilis* CYPERACEAE

### Life history

**Growth form:** Slender perennial herb, with short creeping rhizome; stems tufted or solitary 20–50 cm high.
**Vegetative spread:** Yes.
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–February.
**Fruit/seed:** Golden brown nut 1 mm long, November–March.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST CWS; Qld, Vic., Tas., S.A., N.Z.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Howes Valley, Morisset, Bowen Mountain, Narrabeen, Cheltenham, Kogarah, Kurnell, Cronulla, Leumeah, Yerranderie, Hill Top. **CT:** Rylstone, Clarence, Katoomba, Wheengee-whungee Swamp, Mittagong, Kangaloon.

### Habitat

**Habitat:** Seasonally wet situations, creeks.
**Altitude:** 0–1200 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Swamp e.g. with *Glyceria australis, Myriophyllum simulans, Stellaria angustifolia; Leptospermum* swamp e.g. with *Leptospermum myrtifolium, Carex appressa, Carex gaudichaudiana, Empodisma;* riparian vegetation e.g. with *Lomandra longifolia, Libertia paniculata, Carex appressa.*
**Substrate:** Sandy to clayey alluvial soil, low–medium nutrients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation elsewhere unknown. Reported in Muogamarra NR, Garigal NP, Kanangra Boyd NP.

## *Eleocharis macbarronii* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with small egg-shaped tubers; stems 25–75 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Dark brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NWP SWP; Qld, Vic.
**Distribution Sydney area:** Richmond.
**Select locations:** CC: Richmond (1910).

### Habitat

**Habitat:** Seasonally wet situations.
**Altitude:** 0–50 m **Annual rainfall:** 800 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Clayey soil on alluvium.
**Exposure:**

### Conservation

**Conservation:** Rare, only Sydney area record is for Richmond in 1910.

## *Eleocharis minuta* * CYPERACEAE

Variable Spikerush

### Life history

**Growth form:** Perennial herb, sometimes with short stolons or rhizomes; stems usually tufted 5–20 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:** Less than one year.
**Flowers:** February–June.
**Fruit/seed:** Pale green to dark greenish brown nut 1 mm long, December–June.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Africa.
**Botanical subregions:** NC CC SC; Qld, Vic.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Morisset, Porters Creek, Agnes Banks, Narrabeen (1909), Centennial Park (1899), Padstow, Menangle Park, Coomonderry Swamp, Berry.

### Habitat

**Habitat:** Swamps, sandy shores of coastal lakes.
**Altitude:** 0–50 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Isolepis inundata, Chorizandra cymbaria, Baumea teretifolia, Fimbristylis dichotoma.*
**Substrate:** Sandy to clayey silt on alluvium, sand, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Naturalised for nearly a century.

## *Eleocharis pachycarpa* * CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb, with short rhizome; stems to 20 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Pale yellow-brown nut 1 mm diam.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Chile.
**Botanical subregions:** CC.
**Distribution Sydney area:** Centennial Park.
**Select locations:** CC: Centennial Park (1900, 1908, 1929, 1965, 1975).

### Habitat

**Habitat:** Moist situations.
**Altitude:** 0–50 m **Annual rainfall:** 1200 mm
**Typical local abundance:** Rare.
**Vegetation:** Swamp woodland e.g. with *Melaleuca quinquenervia, Lepyrodia anarthria, Baumea acuta, Schoenus apogon.*
**Substrate:** Peaty soil.
**Exposure:**

### Conservation

**Conservation:** Recorded at Centennial Park at various times (1900–1975), and though persisting there does not seem to have spread beyond.

## *Eleocharis pallens* CYPERACEAE

Pale Spikerush

### Life history

**Growth form:** Tufted perennial herb, with very short rhizome, to 50 cm high; a unique glistening reticulate cell-pattern between the longitudinal ridges of the stem is visible with hand lens (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November.
**Fruit/seed:** Brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic CC, but native in other regions of Australia.
**Botanical subregions:** *CC NT NWS CWS SWS NWP SWP NFWP SFWP; Qld, Vic., N.T., S.A., W.A.
**Distribution Sydney area:** Orange area.
**Select locations:** **CC:** Rooty Hill. **CT:** Belubula River–Junction Reefs.

### Habitat

**Habitat:** Seasonally wet situations, floodways.
**Altitude:** 0–700 m **Annual rainfall:** 700–800 mm
**Typical local abundance:**
**Vegetation:** Riparian vegetation e.g. with *Eucalyptus camaldulensis, Eucalyptus bridgesiana.*
**Substrate:** Sandy riverine alluvium.
**Exposure:**

### Conservation

**Conservation:** Native west of the Great Divide, recorded at Rooty Hill in 1965 but may have been introduced from the west by trains.

## *Eleocharis parvula* * CYPERACEAE

### Life history

**Growth form:** Erect, tufted sedge to 4 cm high, forming grass-like ground cover.
**Vegetative spread:** Probably, it has minute tubers (K. Wilson pers. comm.).
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe, N–S America, N Africa, ?Asia.
**Botanical subregions:** CC; Europe, N–S America, N Africa, ?Asia.
**Distribution Sydney area:** Coastal estuaries.
**Select locations:** **CC:** Chipping Norton Lake (1993), Salt Pan Creek, Revesby (1996), Killalea Lagoon (1994).

### Habitat

**Habitat:** Estuarine mudflats.
**Altitude:** 0–20 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Juncus kraussii, Triglogchin striata, Mimulus repens,* often near mangroves.
**Substrate:** Sandy to muddy alluvium, below high tide level, or with receeding water levels, saline to brackish, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Recently recorded (1993–1996).

## *Eleocharis philippinensis* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with slender rhizomes; stems 25–50 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Straw-coloured to dark brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC:; Qld, W.A., Malesia, N.Cal.
**Distribution Sydney area:** Castlereagh area.
**Select locations:** CC: Londonderry.

### Habitat

**Habitat:** Swampy areas.
**Altitude:** 50 m **Annual rainfall:** 800 mm
**Typical local abundance:** Frequent.
**Vegetation:** Low open-forest.
**Substrate:** Sandy soil on Tertiary alluvium, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Southern geographical limit and only record for Sydney area is for Castlereagh Nature Reserve, collected from 'artificial low-lying area' in 1992.

## *Eleocharis pusilla* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb with slender rhizome; fine stems, usually 2–15 cm high.
**Vegetative spread:** Rhizomatous spread.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** October–March.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:** Germination in all seasons in Northern Tablelands (Britton & Brock 1994).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A., N.Z.
**Distribution Sydney area:** Western Sydney, Bathurst/Orange.
**Select locations:** CC: Richmond, Shane Park, Greystanes Creek, Glenfield, Narellan. CT: Orange, Glanmire, Wombeyan Caves.

### Habitat

**Habitat:** Creeks and swampy areas.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1000 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Marsilea, Juncus, Ranunculus, Carex*.
**Substrate:** Clay soil on shale, alluvium, low to medium nutrients, permanently moist, fresh.
**Exposure:** Full sun.

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Eleocharis sphacelata* CYPERACEAE

Tall Spike Rush

### Life history

**Growth form:** Aquatic perennial herb, rhizomatous, leafless to 2 m high. Flowering stems extend to 1 m above water (Sorrell & Boon 1994).
**Vegetative spread:** Spreads extensively by rhizome in water to 2 m deep (Sainty & Jacobs 1981).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White, October–December.
**Fruit/seed:** Nut 2.5 mm long, October–June.
**Dispersal, establishment & growth:** Diaspore: seed, rhizome fragments. Germination in winter, spring, summer in Northern Tablelands (Britton & Brock 1994).Growth rate quick. Releases methane from wetland sediments (Sorrell & Boon 1994).
**Fire response:**
**Interaction with other organisms:** Roots of E. sphacelata significantly oxidize anaerobic sediments in their vicinity (Sorrell 1994).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST SWS NWP SWP SFWP; Qld, Vic., Tas., N.T., S.A., W.A., N.G.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Mellong, Wyong, Umina, Richmond, Shane Park, Manly Dam, Kogarah, Botany, Glenfield, Narellan, Albion Park. **CT:** Cudgegong River, Bathurst, Blackheath, Woodford, Moss Vale.

### Habitat

**Habitat:** Swamps, wetlands.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–dominant.
**Vegetation:** Sedgeland e.g. with *Phragmites communis, Macherina articulata, Isolepis prolifer, Triglochin, Myriophllum.*
**Substrate:** Sandy to clayey alluvium, low to medium nutrients, permanently moist, watertable high, fresh. Grows mainly in standing water to 2 m deep (Sainty & Jacobs 1981).
**Exposure:** Full sun.

### Conservation

**Conservation:** Conserved in Western Sydney (James et al. 1999), conservation status elsewhere unknown. Reported in Brisbane Water NP, Garigal NP.

## *Fimbristylis dichotoma* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb with very short rhizome; flowering stems compressed, usually 10–75 cm high and much shorter leaves. Variable species with several forms.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–May.
**Fruit/seed:** Biconvex nut.
**Dispersal, establishment & growth:** No particular mechanism for dispersal (McIntyre et al. 1995).
**Fire response:** Possibly resprouted after high intensity fire 1994 (at Lane Cove), fruiting in 18 months (P. Kubiak pers. comm.).
**Interaction with other organisms:** Seed eaten by Straw-necked Ibis and Plumed Whistling Duck *Dendrocygna eytoni* (Barker & Vestjens 1989,1990). Eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT NWS CWS NWP SWP NFWP SFWP; Qld, N.T., S. A., W.A., trop & subtrop regions.
**Distribution Sydney area:** Widespread on coast.
**Select locations:** CC: Calga, Spencer, Pitt Town, Dennistone, North Head, Northbridge, Centennial Park, Homebush, Wongawilli.

### Habitat

**Habitat:** Wetland.
**Altitude:** 0–200 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus fibrosa, E. crebra, E. sclerophylla, E. moluccana* with grassy understorey; wetland margins e.g. with *Baumea rubiginosa, Gahnia sieberiana.*
**Substrate:** Clay soil on shale, alluvium, sandstone, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Fimbristylis ferruginea* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with very short rhizome; stems 20–80 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, N.T., S.A., W.A., pantrop.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Tuggerah Lake, Gosford, Botany Bay, Kurnell, Cronulla.

### Habitat

**Habitat:** Foreshores, lake margins.
**Altitude:** 0–20 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Saltmarsh e.g. with *Juncus kraussii, Isolepis nodosus.*
**Substrate:** Clayey alluvium, saline to brackish.
**Exposure:**

### Conservation

**Conservation:** Port Hacking is southern geographical limit, most recent record 1977. Conservation status unknown.

## *Fimbristylis nutans* CYPERACEAE

### Life history

**Growth form:** Slender, densely tufted perennial herb, with very short rhizome; stems 15–40 cm high, sometimes taller.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, N.T., W.A., Malesia, Asia.
**Distribution Sydney area:** Doonside.
**Select locations:** **CC:** Doonside (1968).

### Habitat

**Habitat:** Around swamps, on moist flats.
**Altitude:** 0–200 m **Annual rainfall:** 900 mm
**Typical local abundance:** Recorded with *Rumex crispus, Cyperus eragrostis, Juncus usitatus.*
**Vegetation:**
**Substrate:** Clay soil, medium nutrients, periodically inundated.
**Exposure:**

### Conservation

**Conservation:** Southern geographical limit and only record for Sydney area is the collection from Doonside near Eastern Creek in 1968. Vulnerable in Western Sydney (James et al. 1999).

## *Fimbristylis velata* CYPERACEAE

### Life history

**Growth form:** Small densely tufted annual, with stems 5–25 cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** January.
**Fruit/seed:** Straw-coloured nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NWP SWP; Qld, Vic., N.T., S.A., W.A., Malasia, Asia.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Pitt Town, Lindfield, Centennial Park, Bondi, Mascot, Camden, Cataract Dam, Pt Kembla.

### Habitat

**Habitat:** Moist areas, lagoon margins, ephemeral watercourses.
**Altitude:** 0–300 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Wetland margins e.g. with *Juncus* species, *Myriophyllum, Marsilea mutica.*
**Substrate:** Sandy soil on sand, sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Fuirena ciliaris* CYPERACEAE

### Life history

**Growth form:** Slender, tufted herb, with flowering stems 40–65 cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:**
**Fruit/seed:** Brown nut 1 mm long, May.
**Dispersal, establishment & growth:**
**Fire response:** Probably killed.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, N.T., W.A., trop. Africa, Asia.
**Distribution Sydney area:** Moorebank.
**Select locations:** CC: Chatham Village.

### Habitat

**Habitat:** Moist situations, swampy flats.
**Altitude:** 0–100 m **Annual rainfall:** 900 mm
**Typical local abundance:** Occasional.
**Vegetation:** Edge of swamp in scrub e.g. with *Melaleuca nodosa, Melaeuca decora, Melaleuca erubescens.*
**Substrate:** Clay soil, low nutrients, periodically wet.
**Exposure:**

### Conservation

**Conservation:** Only record for area is Moorebank in 1992.

## *Gahnia aspera* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with stems 15–65 cm high; leaves flat, scabrous, longer than inflorescence.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** February–May.
**Fruit/seed:** Mature October–February (L. Parkinson pers. comm.).
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990).
**Fire response:**
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla ornata ornata* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS NWP SWP; Qld, Malesia, Polynesia.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wyong, Ourimbah, Mountain Lagoon, West Head, Lane Cove, Kogarah, Botany Bay, Casula, Albion Park, Mt Ousley, Capertee River. **CT:** Mt Victoria, Wombeyan Caves, Mittagong.

### Habitat

**Habitat:** Hillsides, creekbanks.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Edge of rainforest e.g. with *Guioa semiglauca;* open-forest e.g. with *Eucalyptus saligna, E. deanei, E. acmenoides;* woodland e.g. with *Eucalyptus melliodora;* riverine forest e.g. with *Casuarina cunninghamiana, Eucalyptus amplifolia.*
**Substrate:** Clay to sandy soils on shale, basalt, sandstone, alluvium, low to high nutrients, periodically moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP.

## *Gahnia clarkei* CYPERACEAE

### Life history

**Growth form:** Tall tussock-forming perennial herb, with stout stems 80–200 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Flowerheads pendulous and cascading (Romanowski 1998).
**Fruit/seed:** Shiny, orange–red nut 3 mm long, at any time, peak March.
**Dispersal, establishment & growth:** Viability of fresh seed nil (Vigilante et al. (1998).
**Fire response:** New leaves within a month growing from stout, burnt culms (Salvation Creek Jan. 1994). Resprouted after high intensity fire 1994 (at Lane Cove), fruiting in 3 years (P. Kubiak pers. comm.).
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla picta* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Glen Davis, Wyong, Calga, Asquith, Canoelands, Sackville Reach, Cheltenham, Gladesville, Manly, Mosman, Centennial Park, Woronora Dam, Port Hacking River, Darkes Forest, Elderslie, Cambewarra Range. **CT:** Nullo Mountain, Bowen Creek, Wentworth Falls, Lawson, Colo Vale.

### Habitat

**Habitat:** Creekbanks, near swampy areas, gullies.
**Altitude:** 0–900 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus piperita, Angophora costata, Eucalyptus globoidea;* swamp e.g. with *Melaleuca.*
**Substrate:** Sandy soil on sandstone, alluvium, low nutrients. Colonises low pH (2.5–6.5) acid sulphate estuarine soils in the Wyong area (Payne 1992).
**Exposure:**

### Conservation

**Conservation:** Reoprted in Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Sydney Harbour NP, Royal NP.

## *Gahnia erythrocarpa* CYPERACEAE

### Life history

**Growth form:** Tufted perennial, with stout stems 50–150 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–December.
**Fruit/seed:** Nut egg-shaped, 5 mm long, shining, dark red-brown, December–June.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990).
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), flowering in 2 years (P. Kubiak pers. comm.).
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla donnysa donnysa, H. ornata ornata* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC.
**Distribution Sydney area:** Coastal Sydney, Berowra to Waterfall.
**Select locations:** CC: Berowra, West Head, Pennant Hills, Gladesville, Middle Harbour, Long Bay, Heathcote, Waterfall.

### Habitat

**Habitat:** Hillsides, along creeks.
**Altitude:** 0–300 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus pilularis, E. piperita;* riparian forest e.g. with *Ceratopetalum apetalum, Tristaniopsis laurina.*
**Substrate:** Sandy soils on sandstone, alluvium, low nutrients, periodically moist.
**Exposure:**

### Conservation

**Conservation:** Local endemic species with relatively few recent collections. Conservation status unknown. Reported in Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP.

## *Gahnia filifolia* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with slender stems 20–45 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–January, peak October.
**Fruit/seed:** Dark brown nut 3 mm long, March–April.
**Dispersal, establishment & growth:**
**Fire response:** Resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CT ST.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** CT: Clarence, Katoomba, Mt Wilson, Lawson, Kanangra Walls, Mt Werong.

### Habitat

**Habitat:** Dry hillsides.
**Altitude:** 800–1200 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Open-woodland e.g. with *Eucalyptus piperita;* low scrub e.g. with *Eucalyptus stricta.*
**Substrate:** Sandy, sometimes clayey soils on sandstones, quartzite, low nutrients, sometimes moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Gahnia filum* CYPERACEAE

### Life history

**Growth form:** Tussock-forming perennial herb, with stems 60–110 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** April–September.
**Fruit/seed:** Dark brown nut 6 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC; Vic., Tas., S.A.
**Distribution Sydney area:** Georges River estuary.
**Select locations:** **CC:** Mill Creek, Little Salt Pan Creek.

### Habitat

**Habitat:** Saltmarsh or brackish water.
**Altitude:** 0–10 m **Annual rainfall:** 900–1000 mm
**Typical local abundance:** Rare.
**Vegetation:** Upper saltmarsh e.g. with *Juncus kraussii, Sarcocornia quinqueflora, Suaeda australis, Phragmites australis.*
**Substrate:** Sandy sediment, medium nutrients, periodically inundated, saline to brackish.
**Exposure:**

### Conservation

**Conservation:** Known only from a couple of locations each with very few plants in the Georges River estuary, its northern geographical limit. Conservation status unknown.

## *Gahnia grandis* CYPERACEAE

### Life history

**Growth form:** Large tussock-forming perennial herb, with stout stems 100–250 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–May.
**Fruit/seed:** Shiny red-brown to dark brown nut 4 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CT; Vic., Tas.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** **CT:** Clarence, Katoomba, Blackheath.

### Habitat

**Habitat:** Damp places, swamps, wet cliff faces.
**Altitude:** 1000–1100 m **Annual rainfall:** 1100–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Gymnoschoenus sphaerocephalus, Xyris ustulata, Grevillea acanthifolia, Empodisma minus.*
**Substrate:** Sandy soil on sandstone, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Clarence is northern geographical limit. Conservation status unknown. Reported in Blue Mountains NP.

## *Gahnia melanocarpa* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with stout stems 80–120 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Shiny dark brown to black nut 3 mm long. Mature at any time.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990).
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove), fruiting in 2.5 years (P. Kubiak pers. comm.).
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla mastersi mastersi, H. ornata ornata* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST CWS; Qld, Vic.
**Distribution Sydney area:** Coast and Blue Mountains.
**Select locations:** **CC:** Culoul Range, Grose Vale, Ourimbah, Wamberal, Mooney Mooney Creek, Maitland Bay, Lane Cove, Oatley Bay, Palm Creek, Waterfall, Stanwell Park, Kangaroo Valley, Mt Moollatoo, Berry. **CT:** Blackheath, Cedar Gap, Mt Werong.

### Habitat

**Habitat:** Creek, low slopes.
**Altitude:** 0–1100 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Moist open-forest e.g. with *Eucalyptus pilularis, Syncarpia glomulifera, Eucalyptus sieberi, E. radiata, E. dalrympleana, E. deanei, E. saligna, E. acmenoides;* gallery rainforest e.g. with *Ceratopetalum apetalum, Doryphora sassafras, Acmena smithii.*
**Substrate:** Loamy soils on shales, sandy alluvium, low–medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Bouddi NP, Royal NP, Blue Mountains NP.

## *Gahnia microstachya* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with slender stems 20–45 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** March–May.
**Fruit/seed:** Dark grey-brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla ctypsargyra crypsargyra* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ?ST CWS; Vic., Tas.
**Distribution Sydney area:** Mainly Upper Blue Mountains.
**Select locations:** **CC:** Cowan, Mulgoa, Audley. **CT:** Gospers Mountain, Clarence, Blackheath, Mt Banks, Wentworth Falls, Mt Jellore, Carrington Falls.

### Habitat

**Habitat:** Dryish situations, hillsides, gullies.
**Altitude:** 0–1100 m **Annual rainfall:** 900–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus sieberi, E. piperita, Angophora costata, Eucalyptus radiata, E. sclerophylla;* woodland e.g. with *Corymbia gummifera, Corymbia eximia.*
**Substrate:** Sandy soil on sandstone, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Ku-ring-gai Chase NP, Royal NP.

## *Gahnia radula* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with stout stems 50–100 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Shiny nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), flowering in 22 months (P. Kubiak pers. comm.).
**Interaction with other organisms:** Food plant of butterfly larvae *Hesperilla ornata ornata* (Common & Waterhouse 1981). Used by early settlers

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Vic., Tas., S.A.
**Distribution Sydney area:** Mainly coast.
**Select locations:** **CC:** Charlestown, Wyee, Wondabyne, West Head, Bilgola, Frenchs Forest, Pt Hacking, O'Hares Creek, Bargo, Hill Top. **CT:** Mittagong.

### Habitat

**Habitat:** Hillsides.
**Altitude:** 0–600 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus piperita, Angophora costata, Eucalyptus agglomerata;* woodland e.g. with *Corymbia gummmifera;* coastal headland scrub e.g. with *Westringia fruticosa, Allocasuarina distyla.*
**Substrate:** Sandy soil on sandstone, volcanics, low to medium nutrients
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Brisbane Water NP, Ku-ring-gai Chase NP, Royal NP.

## *Gahnia sieberiana* CYPERACEAE

### Life history

**Growth form:** Tall tussock-forming perennial herb, with stems 100–200 cm high.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Relatively narrow, elongated flowerheads (Romanowski 1998).
**Fruit/seed:** Shiny, red to orange nut 4 mm long, January–September. Recruitment mainly after fire (D. Keith pers. comm.).
**Dispersal, establishment & growth:** Germination of seed from regurgitated Currawong pellet (J. Dark, Gumnuts 47) germination of *Gahnia* seed after 1–2 weeks soaking in Coca Cola (C. Peters, Gumnuts 47).
**Fire response:** Resprouts, recondary juvenile period 3 years (D. Keith pers. comm.). New leaves within one month from burnt bases (Salvation Creek 2.1994 LMcD).
**Interaction with other organisms:** Foodplant of butterfly larvae *Tisiphone abeona abeona, Hesperilla idothea idothea, H. ornata ornata* and *Toxidia peron* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST; Qld, Vic., S.A., N.G., N.Cal.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** West Head, Centennial Park, Towra Point, Darkes Forest, Barren Grounds NR, Fitzroy Falls, Berry. **CT:** Ilford, Currant Mountain Gap, Wolgan Gap, Clarence, Mount Tomah, Little Hartley, Katoomba, Wentworth Falls, Blackheath, Jenolan SF, Wombeyan Caves, Robertson, Moss Vale, Bundanoon.

### Habitat

**Habitat:** Creek banks, hillsides.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus sieberi, E. radiata, E. piperita, Corymbia gummifera, Eucalyptus obliqua, E. cypellocarpa;* cliff vegetation e.g. with *Gleichenia rupestris, Dracophyllum secundum.*
**Substrate:** Clay to sandy soils on shale, sandstone, low to medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Ku-ring-gai Chase NP, Royal NP, Barren Grounds NR.

## *Gahnia subaequiglumis* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with stems 30–60 cm high.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Shiny red nut 4 mm long, February–June.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC ST; Qld, Vic., S.A., N.G., N.Cal.
**Distribution Sydney area:** Mainly in Upper Blue Mountains.
**Select locations:** **CC:** Waterfall (1895). **CT:** Wolgan Gap, Clarence, Mt Werong, Boyd Crossing, Wombeyan Caves, Moss Vale (1886).

### Habitat

**Habitat:** Swamp margins, open grassy areas.
**Altitude:** 0–1200 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Woodland e.g. with *Eucalyptus pauciflora, E. dalrympleana, E. dives, E. viminalis;* sedge swamp e.g. with *Leptospermum, Empodisma, Xyris.*
**Substrate:** Peaty to sandy soils on sandstone.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown, now found mainly in Upper Blue Mountains. Reported in Kanangra Boyd NP. Recorded from the coast at Waterfall in 1895, 1896, though not reported since.

## *Gymnoschoenus sphaerocephalus* CYPERACEAE

### Life history

**Growth form:** Large, tussock-forming perennial herb, with stems about 1 m high.
A different form in the Clarence–Newnes area of Blue Mountains is not recognised as a separate species (Harden 1993).
**Vegetative spread:** No.
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** October–May.
**Fruit/seed:** Nut 3 mm long, with shiny pale red-brown inner nut 2 mm long, October–January.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Vic., Tas., S.A.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Narrabeen, North Head, Centennial Park, La Perouse, Darkes Forest, Mt Keira. CT: Mt Coricudgy, Newnes Plateau, Katoomba, Carrington Falls, Fitzroy Falls, Robertson.

### Habitat

**Habitat:** Permanent swamps, wet slopes.
**Altitude:** 0–1100 m **Annual rainfall:** 1000–1800 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedge swamp e.g. with *Lepidosperma limicola, Banksia robur, Xyris species, Gleichenia dicarpa.*
**Substrate:** Sandy to peaty soil on deep sand, sandstone, low nutrients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Isolepis cernua* (*Scirpus cernuus*) CYPERACEAE

Nodding Club-rush

**Life history**

**Growth form:** Small tufted or clump-forming, rhizomatous perennial herb, with stems to 20 cm high. A variable species including several forms over its world range (Harden 1993).
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–January.
**Fruit/seed:** Yellow-brown to dark grey-brown nut 1 mm long, October–March.
**Dispersal, establishment & growth:** Coloniser species.
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST CWS SWS; Qld, Vic., Tas., S.A., W.A., almost cosmopolitan.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Norah Head, Duck River, La Perouse, Kogarah Bay, Kurnell, Cronulla, Casula, Five Islands, Albion Park, Coomonderry Swamp. **CT:** Hartley, Abercrombie Caves.

**Habitat**

**Habitat:** Moist places, beaches, creekbanks, coastal cliffs.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Foreshores e.g. with *Juncus kraussii, Isolepis nodosa, Casuarina glauca;* cliff bases e.g. with *Samolus repens, Lobelia alata;* riparian vegetation e.g. with *Casuarina cunninghamiana, Carex inversa.*
**Substrate:** Sandy soils on sandstone, beach sand, granite, low–medium nutrients, saline to fresh.
**Exposure:**

**Conservation**

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown. Reported in Botany Bay NP.

## *Isolepis crassiuscula* CYPERACEAE

**Life history**

**Growth form:** Aquatic perennial herb, with submerged, creeping stems rooting at nodes or erect and tufted on land.
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–February.
**Fruit/seed:** Shiny, grey-brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Qld, Vic., Tas., N.G., N.Z., Japan.
**Distribution Sydney area:** Boyd Plateau, Southern Highlands.
**Select locations:** **CT:** Jenolan Caves, Boyd River, Robertson, Penrose.

**Habitat**

**Habitat:** Swamps, creeks.
**Altitude:** 600–1200 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Chorizandra sphaerocephala, Lepyrodia anarthria;* creek e.g. with *Leptospermum myrtifolium, Sphagnum.*
**Substrate:** Shallow water or mud, low nutrients.
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown. Reported in Kanangra Boyd NP.

## *Isolepis fluitans* CYPERACEAE

Floating Club-Rush

### Life history

**Growth form:** Slender, aquatic or dry-land perennial herb; stems weak, filiform, leafy, submerged or creeping to erect and tufted to 10 cm high on land.
**Vegetative spread:** Yes.
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Shiny, grey-brown to dark brown nut 1 mm long.
**Dispersal, establishment & growth:** Germination in glasshouse in summer (Britton & Brock 1994). Coloniser.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST; Qld, Vic., Tas., S.A., W.A., N.Z., Malesia, Asia, Eur., Afr.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Narrabeen, Kurnell, Cronulla Beach. **CT:** Berrima (1998).

### Habitat

**Habitat:** Swamps, streams, ephemeral wet places.
**Altitude:** 0–700 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Open-forest e.g. with *Angophora costata, Eucalyptus robusta.*
**Substrate:** Sandy clay soil on alluvium, low nutrients, temporarily moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Isolepis gaudichaudiana* CYPERACEAE

### Life history

**Growth form:** Small tufted annual or possibly perennial herb, with fine stems to 15 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Straw-coloured nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT CT ST SWS; Vic., Tas.
**Distribution Sydney area:** Western Sydney, Orange–Oberon area.
**Select locations:** **CC:** Agnes Banks, Nortons Basin, Elderslie. **CT:** Mt Canobolas, Nashdale, Wattle Flat, Clarence, Blackheath, Luthers Creek, Boyd River.

### Habitat

**Habitat:** Moist situations, creekbanks, seepage areas, swamp margins.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Swampy heath e.g. with *Melaleuca thymifolia, Leptospermum polygalifolium, Leptospermum obovatum;* riparian vegetation e.g. with *Leptospermum grandifolium, Leptospermum obovatum, Hypericum japonicum;* swamps e.g. with *Glyceria australis, Stellaria angustifolia, Eleocharis, gracilis.*
**Substrate:** Sandy to clayey soils on alluvium, sandstone, sand, granite, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Kanangra Boyd NP.

## *Isolepis habra* CYPERACEAE

### Life history

**Growth form:** Slender perennial herb with short rhizome, occasionally proliferating; fine stems to 30 cm high.
**Vegetative spread:** Rhizomatous, mat-forming.
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–March.
**Fruit/seed:** Straw-coloured to pale red-brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST SWS NWP; Qld, Vic., Tas., S.A., W.A., N.Z., Malesia, S.Amer.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wyong, Lower Portland, Cattai, Agnes Banks, Glenbrook, Kowmung River, Cheltenham, Annangrove, Picnic Point, Kurnell, Audley, Bomaderry. **CT:** Orange, Mt Wilson, Katoomba, Blackheath, Hill Top, Mt Werong, Taralga, Robertson.

### Habitat

**Habitat:** Moist places.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus pilularis, E. saligna;* swamp forest e.g. with *Eucalyptus robusta, Melaleuca ericifolia;* swampy heath e.g. with *Lepyrodia scariosa, Melaleuca thymifolia, Banksia robur, Hakea teretifolia;* sedgeland margins e.g. with *Schoenus apogon, Carex appressa, Juncus usitatus.*
**Substrate:** Sandy soils on sand, sandstone, clay soils on alluvium, basalt, low–medium nutrients, periodically wet. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Conserved in Western Sydney (James et al. 1999), conservation status elsewhere unknown. Reported in Garigal NP, Lane Cove NP, Sydney Harbour NP, Botany Bay NP.

## *Isolepis hookeriana* CYPERACEAE

### Life history

**Growth form:** Small tufted annual herb, with fine stems usually to 12 cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:**
**Fruit/seed:** Nut less than 1 mm long, November.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Richmond, Gladesville, St Marys, Leppington, Kangaroo Valley, Shellharbour. **CT:** Ben Bullen, Bathurst, Carcoar, Edith, Wombeyan Caves.

### Habitat

**Habitat:** Moist situations, swamps, streambanks.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus viminalis, E. dalrympleana, E. blakelyi.*
**Substrate:** Clay loam on shale, alluvium, granite, low to medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Isolepis inundata* (*Scirpus inundatus*) CYPERACEAE

### Life history

**Growth form:** Slender, tufted or shortly rhizomatous perennial herb, stems to 50 cm high.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** October–February.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:** Coloniser.
**Fire response:** Flowering 28 and 44 weeks after high intensity fire 1994 (Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST SWS NWP; Qld, Vic., Tas., S.A., W.A., N.Z., Malesia, S.Amer.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Wyong, Lower Portland, Cattai, Agnes Banks, Glenbrook, Kowmung River, Cheltenham, Annangrove, Picnic Point, Kurnell, Audley, Bomaderry. **CT:** Orange, Mt Wilson, Katoomba, Blackheath, Hill Top, Mt Werong, Taralga, Robertson.

### Habitat

**Habitat:** Moist places.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus pilularis, E. saligna;* swamp forest e.g. with *Eucalyptus robusta, Melaleuca ericifolia;* swampy heath e.g. with *Lepyrodia scariosa, Melaleuca thymifolia, Banksia robur, Hakea teretifolia;* sedgeland margins e.g. with *Schoenus apogon, Carex appressa, Juncus usitatus.*
**Substrate:** Sandy soils on sand, sandstone, clay soils on alluvium, basalt, low–medium nutrients, periodically wet. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Conserved in Western Sydney (James et al. 1999), conservation status elsewhere unknown. Reported in Garigal NP, Lane Cove NP, Sydney Harbour NP, Botany Bay NP.

## *Isolepis marginata* * CYPERACEAE

Coarse Club-rush

**Life history**

**Growth form:** Small tufted annual herb, with fine stems to 10 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Straw-coloured to dark brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to S Africa
**Botanical subregions:** CC SC CT ST CWS SWS SWP SFWP; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Cooks River (1902), La Perouse (1996). **CT:** Blackheath (1964).

**Habitat**

**Habitat:** Moist, disturbed situations.
**Altitude:** 0–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:**

**Conservation**

**Conservation:** Few sporadic records within the last 100 years. Potential to invade bush is unknown.

## *Isolepis nodosa* (*Scirpus nodosus*) CYPERACEAE

Knobby Club-rush

**Life history**

**Growth form:** Perennial herb, with stems 15–100 cm high, spread along stout rhizome.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** January–March.
**Fruit/seed:** Dark brown to black nut 1 mm long.
**Dispersal, establishment & growth:** Coloniser.
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic., Tas., S.A., W.A., LHI.
**Distribution Sydney area:** Coastline and estuaries.
**Select locations:** **CC:** Budgewoi, Tuggerah Lake, Avoca, Berowra Creek, Barrenjoey, Epping, Dee Why Lagoon, Manly, Vaucluse, Centennial Park, Kurnell, Bundeena, Gerringong, Windang, Mt Keira, Shellharbour, Berry.

**Habitat**

**Habitat:** Foreshores, lake margins, headlands.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Saltmarsh e.g. with *Juncus kraussii;* dune scrub e.g. with *Melaleuca quinquenervia, Casuarina glauca;* seacliff scrub.
**Substrate:** Sand and mud on foreshores, coastal dunes, low–medium nutrients, saline to brackish.
**Exposure:**

**Conservation**

**Conservation:** Conserved in Western Sydney (James et al. 1999).Reported in Bouddi NP, Brisbane Water NP, Lion Island NR, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Sydney Harbour NP.

## *Isolepis platycarpa* CYPERACEAE

### Life history

**Growth form:** Small tufted annual or short-lived perennial herb, with fine stems to 20 cm high. Closely resembles *I. cernua* (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Dark brown to blackish nut less than 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC ST SWS; Vic., Tas., S.A., W.A., N.I., N.Z.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Toongabbie, Centennial Park, Gerringong,

### Habitat

**Habitat:** Moist situations, creekbanks, lagoons.
**Altitude:** 0–50 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Occasional–rare.
**Vegetation:** Sedgeland e.g. with *Isolepis prolifer, Isolepis inundata, Melaleuca quinquenervia.*
**Substrate:** Clay to peaty sandy soil on sand, alluvium, shale, low to medium nutrients, intermittently moist, brackish to fresh.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Isolepis producta* CYPERACEAE

### Life history

**Growth form:** Aquatic perennial herb, stems submerged and rooting at nodes, occasionally producing small tubers.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–January.
**Fruit/seed:** Shiny grey-brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST; Vic., Tas., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Porters Creek, Putty Creek, Colo River, Cattai, Casula, Glenfield, Mulgoa, Thirlmere, Bomaderry. **CT:** Lidsdale, Wingecarribee Swamp.

### Habitat

**Habitat:** Lagoons, swamps, streams.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swamps with open water e.g. with *Eleocharis sphacelata, Nymphoides geminata, Myriophyllum, Glyceria australis.*
**Substrate:** Mud, mostly inundated but also drying out, low nutrients, permanent moisture.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Isolepis prolifera* * *(Scirpus prolifer)* CYPERACEAE

Budding Club-rush

### Life history

**Growth form:** Slender, tufted or stoloniferous perennial herb, mostly proliferating, stems to 40 cm high, leaves reduced to sheaths. Superficially similar to *I. inundata* (Harden 1993).
**Vegetative spread:** Stoloniferous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** October–April.
**Fruit/seed:** Pale yellow nut 1 mm long, December–May.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouted after high intensity fire 1994 (at Lane Cove), fruiting in 15 months (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** NC CC SC CT; Vic., W.A.
**Distribution Sydney area:** Widespread, mainly coast. Abundant along Yosemite Creek (alongside Blue Mountains Refuse Tip, J. Hosking pers. comm.).
**Select locations:** **CC:** Wyong, Lower Portland, Narrabeen, Curl Curl, Centennial Park (1896), Homebush (1894), Kogarah (1893), Kurnell, Audley, Casula, Dapto, Berry, Kiama, Bomaderry. CT: Robertson.

### Habitat

**Habitat:** Wet places, disturbed sites, riverbank, swamp margins, canals.
**Altitude:** 0–940 m **Annual rainfall:** 800–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Eleocharis sphacelata, Schoenoplectus mucronatus, Carex fascicularis, Juncus usitatus, Juncus articulatus, Persicaria* species.
**Substrate:** Wet muddy or sandy areas, medium nutrients, fresh.
**Exposure:** Full sun.

### Conservation

**Conservation:** Widely naturalised for over a century.

## *Isolepis sepulcralis* * *(Scirpus chlorostachyus)* CYPERACEAE

African Club-sedge

### Life history

**Growth form:** Small tufted annual herb, with stems 4–25 cm high.
**Vegetative spread:**
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:**
**Fruit/seed:** Dark brown to blackish nut less than 1 mm long, October–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** NC CC; Vic.
**Distribution Sydney area:** Widespread in suburban areas.
**Select locations:** **CC:** Hornsby (1914), Baulkham Hills, Cheltenham, Northmead, Concord, Centennial Park (1898), La Perouse, Kogarah (1863), Rookwood, Lansdowne Reserve, Nortons Basin, Narellan.

**Habitat**

**Habitat:** Moist places, creekbanks, drains.
**Altitude:** 0–200 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Melaleuca swamp, riparian forest e.g. with *Ceratopetalum apetalum, Tristaniopsis laurina.*
**Substrate:** Sandy to clay soil on alluvium, medium nutrients, permanently moist.
**Exposure:**

**Conservation**

**Conservation:** Naturalised for over a century.

## ***Isolepis stellata*** *(Scirpus stellatus)* CYPERACEAE

Star Club-rush

**Life history**

**Growth form:** Small tufted annual herb, with stems to cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:**
**Fruit/seed:** Dark brown to black nut less than 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Apparently naturalised in CC, but native to southern Australia (Harden 1993).
**Botanical subregions:** *CC; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Coast.
**Select locations:** CC: La Perouse, Kurnell.

**Habitat**

**Habitat:** Moist sites.
**Altitude:** 0–50 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Open areas in *Leptospermum laevigatum* shrubland e.g. with *Centrolepis strigosa, Isolepis inundata.*
**Substrate:** Sandy soil on sandstone, low nutrients, moist.
**Exposure:**

**Conservation**

**Conservation:** Apparently naturalised in CC, but native to southern Australia (Harden 1993).

## *Isolepis subtilissima* CYPERACEAE

### Life history

**Growth form:** Small pernnial herb, with short, fine rhizome; fine stems to 10 cm high. Closely resembes *I. habra* (Harden 1993).
**Vegetative spread:** Mat-forming.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Pale yellow to pale red-brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT CT ST; Qld, Vic., Tas., N.Z., Malesia.
**Distribution Sydney area:** Mainly at high elevations.
**Select locations:** **CC:** Macquarie Rivulet. **CT:** Mt Canobolas, Lidsdale, Blackheath, Wentworth Falls, Luthers Creek, Boyd Plateau, Wildes Meadow.

### Habitat

**Habitat:** Moist places, creekbanks, swamps.
**Altitude:** 0–1200 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent–rare.
**Vegetation:** Sedgeland e.g. with *Hydrocotyle peduncularis, Hypericum japonicum, Deyeuxia gummifera, Isolepis subtilissima, Scirpus polystachyus.*
**Substrate:** Peaty soils, alluvium, low nutrients, periodically wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown, only one record at low elevation at Macquarie Rivulet in 1992. Reported in Kanangra Boyd NP.

## *Lepidosperma concavum* (*L. squamatum*) CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with long vertical rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time of year.
**Fruit/seed:** Pale to dark brown nut 4 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Food plant of butterfly larvae *Motasingha dirphia dilata* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST; Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Norah Head, Hornsby, North Head, Rose Bay, Lady Robinsons Beach, Rockdale, Padstow, Kurnell, Loftus, Marley, Darkes Forest, Bargo River, Mt Kembla. **CT:** Wentworth Falls, Lawson, Hill Top.

### Habitat

**Habitat:** Ridges.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Heath e.g. with *Leptospermum laevigatum,* mallee eucalypts; open-forest e.g. with *Angophora costata, Eucalyptus piperita, Corymbia gummifera;* moist forest e.g. with *Ceratopetalum apetalum.*
**Substrate:** Sandy soils on sandstone and dune sand, low nutrients, well-drained, sometimes moist sites.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Royal NP.

## *Lepidosperma curtisiae* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial, with very short rhizome; stems 2–25 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October.
**Fruit/seed:** Grey-green to dark brown nut 3 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** SC NT CT ST; Vic., Tas., S.A.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** **CT:** Blackheath.

### Habitat

**Habitat:** Cliff edges.
**Altitude:** 1000 m **Annual rainfall:** 1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Cliff heath e.g. with *Allocasuarina nana, Banksia ericifolia.*
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Rare, only known from Blackheath in Sydney area.

## *Lepidosperma elatius* CYPERACEAE

### Life history

**Growth form:** Tall tufted perennial herb, with short rhizome; stems 70–180 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–April.
**Fruit/seed:** Greyish to red-brown nut 3 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Qld, Vic., Tas.
**Distribution Sydney area:** Mainly coast.
**Select locations:** CC: Wyong, Ourimbah, Cowan, Bayview, Allambie Heights, Lane Cove. CT: Blackheath.

### Habitat

**Habitat:** Damp areas, creeks.
**Altitude:** 0–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Moist open-forest e.g. with *Eucalyptus pilularis, Angophora costata, Syncarpia glomulifera, Eucalyptus punctata, E. piperita, Corymbia gummifera.*
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Mainly coastal, only record for Blue Mountains was Blackheath in 1926. Conservation status not known. Reported in Ku-ring-gai Chase NP.

## *Lepidosperma evansianum* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb 20–55 cm high, with a short rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January.
**Fruit/seed:** Straw-coloured or grey-green nut 4 mm long, January.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CT.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** CT: Blackheath, Wentworth Falls.

### Habitat

**Habitat:** Moist cliff faces, rock ledges.
**Altitude:** 600–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare–frequent.
**Vegetation:** Sedgeland e.g. with *Gymnoschoenus sphaerocephalus, Empodisma minus, Xyris ustulata, Grevillea acanthifolia, Lepyrodia gracilis.*
**Substrate:** Moist sandy soils on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Local endemic restricted to 3 populations at Blackheath and Wentworth Falls, listed as Vulnerable (Schedule 2) under NSW *Threatened Species Conservation Act 1995*. Reported in Blue Mountains National Park but threatened by urban run-off, weed encroachment and track encroachment.

## ***Lepidosperma filiforme*** *(L. flexuosum)* CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb, with very short rhizome; stems 30–100 cm high.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** January–May, peak May.
**Fruit/seed:** Grey-green to red-brown nut 4 mm long, July–December.
**Dispersal, establishment & growth:** ? Myrmecochore (Rice & Westoby 1981). Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST; Vic., Tas., ?S.A., N.Z.
**Distribution Sydney area:**
**Select locations:** **CC:** Colo, Cowan, Hornsby, Belrose, Linden, Lane Cove, La Perouse, Heathcote, Loddon River, Barren Grounds, Darkes Forest, Bulli Pass. **CT:** Gospers Mountain, Blackheath, Wentworth Falls, Boyd Crossing.

### Habitat

**Habitat:** Ridges, hillsides, creekbanks.
**Altitude:** 0–1100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Ptilanthelium deustum, Schoenus imberbis, Caustis flexuosa, Allocasuarina nana, Eucalyptus stricta.*
**Substrate:** Sandy soils on sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Garigal NP, Royal NP, Kanangra Boyd NP.

## ***Lepidosperma forsythii*** CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb with short rhizome; stems mostly 60–120 cm.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** February–August.
**Fruit/seed:** Grey-brown nut 5 mm long, May–August.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Vic., Tas.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Centennial Park, La Perouse, Kurnell, Audley, Uloola Swamp, Bulli Pass. **CT:** Wentworth Falls, Bundanoon.

### Habitat

**Habitat:** Swampy heath.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Moist heath e.g. with *Banksia robur, Hakea teretifolia, Sprengelia incarnata;* sedge swamp e.g. with *Gymnoschoenus sphaerocephalus, Gleichenia dicarpa, Empodisma minus.*
**Substrate:** Sandy to clayey soils on sandstone, sand, low nurients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Lepidosperma gunnii* CYPERACEAE

### Life history

**Growth form:** Slender, tufted perennial herb, with short rhizome; stems 15–40 cm high. Similar to *L. laterale* (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–September.
**Fruit/seed:** Pale brown nut 3 mm long, November–September.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST CWS; Qld, Vic., Tas.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Howes Valley, Lane Cove, Strathfield, Bass Hill, Penrith, Glenbrook, Curra Moors. **CT:** Pantoneys Crown, Mt Blaxland, Penrose.

### Habitat

**Habitat:** Ridges, hillsides.
**Altitude:** 0–800 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus radiata, E. sclerophylla, E. agglomerata, E. punctata, Angophora costata, Eucalyptus sieberi, Syncarpia glomulifera;* woodland e.g. with *Eucalyptus albens, E. crebra, Callitris endlicheri, Eucalyptus pulverulenta.*
**Substrate:** Clay soils on shale, limestone, granite, trachyte, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Royal NP.

## *Lepidosperma latens* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with short rhizome; stems 35–60 cm high.
**Vegetative spread:** Rhizomatous, spreading up to 1 square metre (Herb. note).
**Longevity:** Indefintite.
**Primary juvenile period:**
**Flowers:** September–May.
**Fruit/seed:** Dark grey to red-brown nut 3 mm long, September–May.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST.
**Distribution Sydney area:**
**Select locations:** **CC:** Morisset, Cowan, Dural, Pennant Hills Park, Lane Cove, O'Hares Creek. **CT:** Newnes SF, Clarence, Mt Wilson, Mount Tomah, Blackheath.

### Habitat

**Habitat:** Ridgetops.
**Altitude:** 0–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Eucalyptus stricta, Allocasuarina nana, Isopogon anethifolius, Corymbia gummifera;* open-woodland e.g. with *Eucalyptus sieberi, E. puncata, E. haemastoma.*
**Substrate:** Sandy soils on sandstone, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Ku-ring-gai Chase NP.

## *Lepidosperma laterale* (*L. lineare*) CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with very short rhizome; stems 30–100 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time of year.
**Fruit/seed:** Pale to dark brown nut 4 mm long, At any time of year.
**Dispersal, establishment & growth:** Ant-adapted food body for dispersal (Westoby et al. 1990, Rice & Westoby 1981).
**Fire response:** Resprouts from base (Bantry Bay, LMcD), fruiting one year later after high intensity fire 1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:** Seed eaten by Crimson Rosella *Platycercus elegans* (Lepschi 1993). Sometimes eaten by rabbits, particularly smaller plants (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS SWP; Qld, Vic., Tas., S.A., N.Cal., N.Z.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Wyong, Cowan, Pearl Beach, Arcadia, Asquith, Springwood, Glenbrook, Lane Cove, Kemps Creek, Bass Hill, Macquarie Fields, Loftus, Campbelltown, Werong Beach, Stanwell Park, Wollongong, Kangaroo Valley, Bombaderry Creek.
CT: Mt Coricudgy, Gospers Mountain, Glen Davis, Orange, Mt Wilson, Tarana, Mt Blaxland, Blackheath, Wentworth Falls, Abercrombie Caves, Kanangra Walls, Wombeyan Caves, Mittagong, Fitzroy Falls, Penrose,.

### Habitat

**Habitat:** Rocky hillsides, creeks.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus piperita, E. pilularis, E. punctata, Syncarpia glomulifera, Angophora costata;* woodland e.g. with *Eucalyptus tereticornis, E. fibrosa, E. bridgesiana, E. melliodora.*
**Substrate:** Sandy soils on sandstones, granite, sandy clay on shale, basalt, low–medium nurients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Probably adequately conserved. Reported in Blue Mountains NP, Brisbane Water NP, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Dalrymple Hay NR, Lane Cove NP, Royal NP, Morton NP.

## *Lepidosperma limicola* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with short vertical rhizome; stems 60–150 cm high.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** At any time of year, peak April.
**Fruit/seed:** Pale brown to greyish brown nut 3 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST; Qld, Vic.
**Distribution Sydney area:** Widespread, mainly south of Sydney.
**Select locations:** CC: Botany Bay, Sutherland, Darkes Forest, Barren Grounds. CT: Coricudgy, Newnes SF, Clarence, Mt Wilson, Wentworth Falls, Yerranderrie, Bindook Swamp, Fitzroy Falls, Wingello.

### Habitat

**Habitat:** Swampy areas, depressions.
**Altitude:** 0–1100 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Shrubswamp e.g. with *Leptospermum lanigerum, Baeckea linifolia, Grevillea acanthifolia, Gymnoschoenus sphaerocephalus.*
**Substrate:** Sandy soil over sandstone, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Lepidosperma longitudinale* CYPERACEAE

### Life history

**Growth form:** Clump-forming perennial herb, with short thick rhizome; stems 60–200 cm high.
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time of year.
**Fruit/seed:** Pale to dark brown nut 3 mm long. Viability of fresh seed nil (Vigilante et al. (1998).
**Dispersal, establishment & growth:** ? Myrmecochore (Rice & Westoby 1981). Germination after smoke (Greening Australia 1996c).
**Fire response:** Resprouts at base or below (Fox 1988, Vigilante et al. (1998).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** CC: Wyong, Glenbrook Lagoon, Agnes Banks, Kensington, La Perouse, Moorebank, Thirlmere Lakes, Bargo River. CT: Nattai Creek.

### Habitat

**Habitat:** Edge of lakes.
**Altitude:** 0–600 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Dominant–frequent.
**Vegetation:** Sedgeland e.g. with *Lepironia, Eleocharis sphacelata;* swamp forest e.g. with *Eucalyptus robusta, Melaleuca linariifolia.*
**Substrate:** Deep sand, alluvium, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Reported in Royal NP, Thilmere Lakes NP.

## *Lepidosperma neesii* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb, with long rhizome; stems usually 20–65 cm high.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** Flowers abundantly only after fire (Keith 1996), November–March, peak January.
**Fruit/seed:** Whitish to pale red-brown nut 3 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 2 years (D. Keith pers. comm.), less than 15 months after high intensity fire 1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:** Some plants eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Vic.
**Distribution Sydney area:**
**Select locations:** **CC:** Wyee, Hornsby, Terrey Hills, Collaroy, Lindfield, Castlecove, Lane Cove, Centennial Park, Kogarah, Loftus, Picnic Point, Maddens Plains.
CT: Newnes SF, Wentworth Falls, Woodford, Hill Top, Penrose.

### Habitat

**Habitat:** Hillsides.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Heath e.g. with *Allocasuarina nana, Lepidosperma viscidum, Melaleuca nodosa, Allocasuarina distyla;* woodland e.g. with *Eucalyptus sieberi, Corymbia gummifera.*
**Substrate:** Sandy soils on sandstone, low nutrients, moist, poorly-drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Ku-ring-gai Chase NP, Royal NP, Blue Mountains NP.

## *Lepidosperma quadrangulatum* CYPERACEAE

### Life history

**Growth form:** Tufted, glaucous perennial herb, with a long rhizome; stems 4-angled, 45–150 cm high.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** White to yellow-brown nut 3 mm long.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Warnervale, Kincumber, Bensville, Woy Woy, Dee Why Lagoon, Maroubra Beach, Waterfall.

### Habitat

**Habitat:** Coastal wet heath or swamp forest.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare–frequent.
**Vegetation:** Sedgeland e.g. with *Schoenus brevifolius, Lepyrodia scariosa, Gymnoschoenus sphaerocephalus, Banksia robur;* wetland with *Baumea juncea,* estuarine wetland with *Melaleuca ericifolia, Juncus kraussii, Schoenus nitens;* swamp with *Eucalyptus robusta, Melaleuca linariifolia.*
**Substrate:** Clay loams and organic sands and peat over sandstone, deep sandy alluvial soil, impeded drainage, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Restricted to isolated pockets, many of which are likely to disappear within 5 years. Inadequately conserved in the Sydney area. Threatened by urban development changes in watertables, invasion by *Imperata cylindrica* as a result of fire and sedimentation (R. Payne pers. comm. 1997). Not uncommon from Gosford to Port Macquarie (Van Klapake pers. comm.).

## *Lepidosperma tortuosum* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb, with very short rhizome; stems often twisted 10–35 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Grey-green nut 3 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC NT CT ST; Vic., Tas., ?S.A.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** **CT:** Newnes SF, Clarence, Blackheath, Wentworth Falls, Boyd River, Kanangra.

### Habitat

**Habitat:** Moist slopes.
**Altitude:** 800–1100 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Heath e.g. with *Eucalyptus stricta;* woodland e.g. with *Eucalyptus pauciflora, E. dives, E. sieberi, E. mannifera, E. radiata.*
**Substrate:** Sandy soil on sandstone, granite, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Lepidosperma urophorum* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with very short rhizome; stems 60–150 cm high.
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Pale brown to dark greyish nut 3–4 mm long.
**Dispersal, establishment & growth:** Ant-adapted food body for dispersal (Westoby et al. 1990, Rice & Westoby 1981).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST; Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Hunter Range, Culoul Range, Gospers Creek, Bilpin, Springwood, Killara, Mulgoa, Douglas Park, O'Hares Creek, Berry, Barrengarry, **CT:** Blackheath, Moorara Range, Fitzroy Falls.

### Habitat

**Habitat:** Rocky areas, often near streams, cliff edges.
**Altitude:** 0–1200 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus radiata, E. baxlandii, E. piperita, Angophora costata, Syncarpia glomulifera, Ceratopetalum apetalum.*
**Substrate:** Sandy soils on sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Reported in Wollemi NP, Blue Mountains NP, Kanangra Boyd NP.

## *Lepidosperma viscidum* CYPERACEAE

### Life history

**Growth form:** Clump-forming perennial herb, with short rhizome; stems 35–60 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time of year, peak May.
**Fruit/seed:** Pale to dark brown nut 3 mm long.
**Dispersal, establishment & growth:** Adapted for ant-dispersal (Rice & Westoby 1981).
**Fire response:** Stems killed, resprouts from base.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC ?NT CT CWS; Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Coast and Blue Mountains.
**Select locations:** CC: Wondabyne, Linden, North Head, Bondi, Botany, Bundeena, Appin. CT: Gospers Mountain, Hassans Walls, Clarence, Blackheath, Mt Banks, Katoomba, Wentworth Falls, Kanangra Tops.

### Habitat

**Habitat:** Sandy or rocky ridges.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Heath e.g. with *Allocasuarina nana, Banksia ericifolia, Caustis recurva, Lepidosperma flexuosum, Allocaluarina distyla, Darwinia fascicularis;* sea cliff scrub.
**Substrate:** Shallow sandy soil on sandstone, sand dunes, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Brisbane Water NP, Ku-ring-gai Chase NP, Royal NP.

## *Lepironia articulata* CYPERACEAE

### Life history

**Growth form:** Large, rush-like perennial herb, with stout woody rhizome; stems grey-green or glaucous 40–200 cm high.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** October–February.
**Fruit/seed:** Brown nut 3–6 mm long, February–March.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Aboriginal people reported to have eaten rhizomes (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, N.T., Malesia, N. Cal., Madagascar.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Colo River, Umina, Glenbrook, Thirlmere Lakes, Coomonderry Swamp.

### Habitat

**Habitat:** Lake edges extending into water.
**Altitude:** 0–200 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Occasional–frequent (dominant).
**Vegetation:** Sedgeland e.g. with *Eleocharis sphacelata, Melaleuca linariifolia;* swamp e.g. with *Melaleuca quinquenervia, Hypolepis muelleri, Baumea articulata.*
**Substrate:** Sandy sediments, low nutrients, permanently moist, up to 1 m deep.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown, Thirlmere Lakes is southern geographical limit. Reported in Thirlmere Lakes NP.

## *Lipocarpha microcephala* (*Rikliella australiensis*) CYPERACEAE

### Life history

**Growth form:** Slender annual herb, with stems to 35 cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** March.
**Fruit/seed:** Pale brown nut 1 mm long, April–May.
**Dispersal, establishment & growth:** Germination in all seasons in Northern Tablelands (Britton & Brock 1994).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NWS CWS SWS NWP SWP NFWP; Qld, Vic., S.A., W.A., Malesia to Japan.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Mellong Swamp, Richmond, Agnes Banks, Springwood, Linden, Lane Cove, Penrith, Centennial Park, Menangle Park.

### Habitat

**Habitat:** Damp places, stream banks, seepage areas.
**Altitude:** 0–400 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–rare.
**Vegetation:** Moist grassland e.g. with *Fimbristylis dichotoma, Eleocharis minuta, Cyperus* species.
**Substrate:** Sandy soils on sandstone, sandy alluvium, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## ***Ptilothrix deusta*** *(Ptilanthelium deustum)* CYPERACEAE

### Life history

**Growth form:** Slender tufted perennial herb, with rigid, nodeless flowering stems usually to 50 cm high; inflorescence with numerous spikelets clustered within large bracts, with black-brown sheathing bases.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** Flowers abundantly only after fire (Keith 1996), April–October.
**Fruit/seed:** Dark brown to blackish nut 5 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts (e.g. at Agnes Banks, Benson 1981), secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:** Leaves eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS; Qld.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Mellong Swamp, Gosford, Maroota, Londonderry, Glenbrook, Dural, Thornleigh, Newport, Roseville, Waterfall, Douglas Park, Appin, Maddens Plain, Maldon, Thirlmere. **CT:** Bell, Mt Wilson, Blackheath, Leura, Woodford, Burragorang, Carrington Falls.

### Habitat

**Habitat:** Hillsides, swamp margins.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Wet heath e.g. with *Banksia robur, Cyathochaeta diandra;* woodland e.g. with *Corymbia gummifera, Angophora hispida, Banksia ericifolia;* open-woodland e.g. with *Angophora bakeri, Eucalyptus sclerophylla, Melaleuca decora.*
**Substrate:** Sandy soil on sandstone, Tertiary alluvium, low nutrients, periodically moist.
**Exposure:** Full sun.

### Conservation

**Conservation:** Probably adequately conserved Reported in Brisbane Water NP, Castlereagh NR, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Dalrymple Hay NR, Lane Cove NP, Sydney Harbour NP, Royal NP.

## ***Rhynchospora brownii*** *(R. glauca)* CYPERACEAE

### Life history

**Growth form:** Slender tufted perennial herb, with short rhizome; flowering stems 30–90 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** December–February.
**Fruit/seed:** December–June.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT; Qld, Vic., N.T., Malesia, Asia, Afr.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Northbridge, Bundeena, Menangle Park.

### Habitat

**Habitat:** Beside streams, in swamps, along drainage lines, creekflats.
**Altitude:** 0–300 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Creekside vegetation e.g. with *Chorizandra cymbaria, Schoenus melanostachys, Gahnia clarkei, Leptospermum polygalifolium, Phragmites australis, Carex appressa, Melaleuca.*
**Substrate:** Sandy soils on sandstone, alluvium, low–medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## ***Schoenoplectus erectus* *** *(Isolepis erectus)* CYPERACEAE

Soft Club-rush

### Life history

**Growth form:** Annual tufted herb, with nodeless flowering stems to 30 cm high.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** December–January.
**Fruit/seed:** Nut 1 mm long, April–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Africa.
**Botanical subregions:** CC NWP; Qld, Vic.
**Distribution Sydney area:** Western Sydney.
**Select locations:** **CC:** Agnes Banks (1993), Moorebank, Menangle Park (1967).

### Habitat

**Habitat:** Damp, open disturbed situations, lagoons, road gutters.
**Altitude:** 0–100 m **Annual rainfall:** 700–900 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Lagoon edge e.g. with *Philydrum lanuginosum, Juncus continuous; Melaleuca* scrub e.g. with *Melaleuca nodosa, Melaleuca decora, Melaleuca erubescens.*
**Substrate:** Sandy to clayey soil on alluvium, sand.
**Exposure:**

### Conservation

**Conservation:** First reported at Menangle Park (1967, 1971, 1973). Large increase in extent at Moorebank (1989–1992) (Herb. record). Likely to spread further e.g. disturbed lagoon at Anges Banks (1993).

## *Schoenoplectus lineolatus* * CYPERACEAE

Linear Club-rush

### Life history

**Growth form:** Small perennial herb, with long rhizome; stems to 35 cm high, solitary at distant nodes of rhizome.
**Vegetative spread:** Rhizomatous spread up to 1 square metre (Herb. note).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** January–March.
**Fruit/seed:** Dark brown nut 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Japan, Taiwan.
**Botanical subregions:** CC NWS; Vic.
**Distribution Sydney area:** Manly Dam.
**Select locations:** **CC:** Manly Dam (1988), Nepean River (1899).

### Habitat

**Habitat:** Swampy areas.
**Altitude:** 0–50 m **Annual rainfall:** 800–1200 mm
**Typical local abundance:** Rare.
**Vegetation:** Sedgeland e.g. with *Eleocharis sphacelata, Isolepis inundata.*
**Substrate:** Mud, low nutrients, periodically or permanently inundated.
**Exposure:**

### Conservation

**Conservation:** Recently recorded at Manly Dam (1988, 1990) the first record for Sydney area since 1899. Potential spread unknown.

## *Schoenoplectus mucronatus* (*Scirpus mucronatus*) CYPERACEAE

### Life history

**Growth form:** Rhizomatous perennial herb; flowering stems to 50–100 cm high, with reduced leaves.
**Vegetative spread:**
**Longevity:** Perennial.
**Primary juvenile period:**
**Flowers:** December–March.
**Fruit/seed:** January–May, seed 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT NWS; Qld, N.T., W.A., Malesia, Eurasia, Vanuatu.
**Distribution Sydney area:** Coast and western Sydney.
**Select locations:** **CC:** Lower Portland, Castlereagh, Shane Park, Macquarie Fields, Glenfield, Centennial Park (1896), Audley.

### Habitat

**Habitat:** Wetlands, excavated sites.
**Altitude:** 0–200 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional–frequent.
**Vegetation:** Wetland e.g. with *Eleocharis sphacelata, Myriophyllum latifolium, Persicaria hydropiper, Juncus usitatus, Melaleuca linariifolia;* woodland e.g. with *Eucalyptus parramattensis, Melaleuca nodosa, Melaleuca decora.*
**Substrate:** Wet mud of sandy soil on alluvium, Tertiary alluvium, low nutrients, moist.
**Exposure:** Full sun.

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Status elsewhere unknown.

## ***Schoenoplectus subulatus*** *(Scirpus litoralis)* CYPERACEAE

### Life history

**Growth form:** Tall rhizomatous perennial herb, with flowering stems 60–150 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–March.
**Fruit/seed:** Grey-brown to dark brown nut, 2 mm long, January–May.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Foodplant of Pacific Black Duck *Anas superciliosa,* Grey Teal *Anas gibberifrons,* seed eaten by Plumed Whistling Duck *Dendrocygna eytoni,* and Black Swan *Cygnus atratus* (Barker & Vestjens 1989,1990). Rhizomes reported to be edible after pounding or grinding and baking (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld, N.T., S.A., W.A., Medit. region to Africa & Asia.
**Distribution Sydney area:** Coastal Sydney.
**Select locations:** **CC:** Narrabeen, Manly (1888), Silverwater, Cooks River (1916), Tempe (1894), Kurnell, Towra Point.

### Habitat

**Habitat:** Brackish to freshwater swamps, drains.
**Altitude:** 0–50 m **Annual rainfall:** above 1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Wetland margin, saltmarsh and *Casuarina glauca.*
**Substrate:** Mud, water table mostly high, sometimes in tidal zone, saline to brackish.
**Exposure:**

### Conservation

**Conservation:** Rare, conservation status unknown.

## *Schoenoplectus validus* (*Scirpus validus*) CYPERACEAE

### Life history

**Growth form:** Tall rhizomatous perennial herb, with flowering stems 100–200 cm high, leaves reduced.
**Vegetative spread:** Rhizomatous.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** November–March.
**Fruit/seed:** Grey-brown to dark-brown nut 2 mm long, January–May.
**Dispersal, establishment & growth:** Seed weight 0.98 mg, germination 47% within 30 days (Shipley & Parent 1991). Coloniser. Can be grown in wide range of nutrient and organic matter strengths, particularly in high nutrient agricultural wastewaters (Tanner 1994).
**Fire response:**
**Interaction with other organisms:** Foodplant of Black Swan *Cygnus atratus*, Pacific Black Duck *Anas superciliosa*, Grey Teal *Anas gibberifrons* and Freckled Duck *Stictonetta naevosa* (Barker & Vestjens 1989,1990). Rhizomes reported to be edible after pounding or grinding and baking (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT ST NWS SWS NWP SWP NFWP SFWP; Qld, Vic., Tas., S.A., W.A., N. Cal.
**Distribution Sydney area:** Widespread on coast.
**Select locations:** **CC:** Bucketty, Richmond, Manly, Toongabbie, Shane Park, St Marys, Cooks River, Kurnell, Kogarah, Woolooware Bay, Lake Illawarra, Berry, Kangaroo Valley, Shoalhaven River. **CT:** Bowral.

### Habitat

**Habitat:** Creeks, lakes, open swamps.
**Altitude:** 0–700 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional–frequent.
**Vegetation:** Wetland species e.g. *Persicaria, Phragmites australis, Casuarina glauca.*
**Substrate:** In or on edge of shallow water, clay soil on shale, water table permanently high, freshwater to brackish. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:** Full sun.

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Reported in Botany Bay NP.

## *Schoenus apogon* CYPERACEAE

### Life history

**Growth form:** Tufted annual herb, with flowering stems 3–25 cm high.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** January–April.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995). Recruitment mainly after fire (D. Keith pers. comm.). Germination outside in autumn, winter, spring in Northern Tablelands (Britton & Brock 1994).
**Fire response:** Resprouts e.g. at Agnes Banks (Benson 1981), secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP; Qld, Vic., Tas., S.A., N.Z.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Lake Macquarie, Wyong, Gosford, Mt Yengo, Castlereagh SF, Asquith, Cheltenham, Manly, Centennial Park, Lakemba, Kurnell, Menangle Park, Darkes Forest, Foxground. **CT:** Orange, Mt Jellore, Kangaloon, Bundanoon.

### Habitat

**Habitat:** Seasonally wet habitats.
**Altitude:** 0–800 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus sieberi, Corymbia gummifera, Eucalyptus sclerophylla, E. mannifera, E. radiata;* sedgeland e.g. with *Empodisma, Leptocarpus tenax, Lepidosperma longitudinale.*
**Substrate:** Sandy soil on sandstone, alluvium, low nutrients, moist. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Schoenus brevifolius* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with short stout rhizome; flowering stems 30–90 cm long.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** Visited by Honeybees for pollen, possibly effecting some pollination (P. Kubiak pers. comm.), October–February.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.). Resprouted at Agnes Banks (Benson 1981).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Qld, Vic., Tas., W.A., N.Z., N. Cal.
**Distribution Sydney area:** Mainly coast.
**Select locations:** **CC:** Putty, Wyong, Gosford, Cowan, Agnes Banks, Avalon, Centennial Park, Sutherland, Sublime Point, Appin, Thirlmere Lakes, Darkes Forest. **CT:** Leura, Barren Grounds.

### Habitat

**Habitat:** Swamps, damp heath.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Banksia robur, Banksia ericifolia, Gahnia sieberiana;* low woodland e.g. with *Eucalyptus parramattensis, Angophora bakeri, Eucalyptus sieberi, E. piperita.*
**Substrate:** Sandy soils on sandstone, sand, low nutrients, periodically moist, inundated.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Schoenus ericetorum* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with flowering stems 15–40 cm long.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** September–October.
**Fruit/seed:** Nut 2 mm long.
**Dispersal, establishment & growth:** Dispersal: no special morphology (Westoby et al. 1990). Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts (D. Keith pers. comm., Benson 1981, Fox 1988), flowering 10 months after high intensity fire 1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST NWS CWS NWP; Qld, Vic., Tas., W.A., N.Z., N Cal.
**Distribution Sydney area:** Coast and Blue Mountains.
**Select locations:** **CC:** Putty, Somersby, Hornsby, Agnes Banks, Cheltenham, Lane Cove, Rockdale, La Perouse, Waterfall, Menangle Park, Cataract Dam, Bulli. **CT:** Currant Mountain Gap, Hassans Walls, Bell, Blackheath, Katoomba, Kanangra Tops, Hill Top, Penrose.

### Habitat

**Habitat:** Ridges, slopes.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Allocasuarina distyla, Allocasuarina nana, Banksia ericifolia, Baeckea brevifolia, Lepidosmerma;* woodland e.g. with *Eucalyptus haemastoma, Eucalyptus sieberi, E. sclerophylla, Angophora bakeri, Eucalyptus radiata, E. mannifera.*
**Substrate:** Sandy soils on sandstone, sand, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Widespread and probably adequately conserved. Reported in Brisbane Water NP, Muogamarra NR, Garigal NP, Dalrymple Hay NR, Lane Cove NP, Barren Grounds NR.

## *Schoenus evansianus* CYPERACEAE

### Life history

**Growth form:** Small, tufted perennial herb, with short rhizome; flowering stems 4–12 cm long.
**Vegetative spread:** No.
**Longevity:**
**Primary juvenile period:**
**Flowers:** April.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** SC CT ST.
**Distribution Sydney area:** Kanangra.
**Select locations:** CT: Kanangra Walls..

### Habitat

**Habitat:** Seepage areas on sandstone outcrops.
**Altitude:** 1200 m **Annual rainfall:** 1000 mm
**Typical local abundance:** Frequent.
**Vegetation:** Rock platform heath e.g. with *Baeckea brevifolia, Eucalyptus stricta;* sedgeland e.g. with *Carex appressa, Empodisma minus, Isolepis crassiuscula.*
**Substrate:** Shallow sandy soils on sandstone, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Kanangra Walls is northern geographical limit. Reported in Kanangra Boyd NP.

## *Schoenus imberbis* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with flowering stems 8–35 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time, peak November–May.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990).
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), fruiting in 18 months (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC CT; Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Howes Valley, Kulnura, Woy Woy, Calga, Cowan, Wisemans Ferry, Grose Vale, Springwood, Hornsby, Narrabeen, Centennial Park, Woronora River, Bargo, Burragorang Valley. **CT:** Mt Darcy, Gospers Mountain, Glen Davis, Mt Banks, Wentworth Falls.

### Habitat

**Habitat:** Ridges, hillsides.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Corymbia eximia, Corymbia gummifera, Eucalyptus piperita, Banksia serrata, Angophora bakeri;* mallee and scrub e.g. with *Eucalyptus stricta, E. burgessiana, E. laophylla.*
**Substrate:** Sandy soil on sandstones, low nutrients, dry.
**Exposure:**

### Conservation

**Conservation:** Probably adequately conserved. Reported in Blue Mountains NP, Brisbane Water NP, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Sydney Harbour NP.

## *Schoenus lepidosperma* subsp. *pachylepis* CYPERACEAE

### Life history

**Growth form:** Perennial tufted herb, with very short rhizome; flowering stems 10–60 cm long.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** July–November.
**Fruit/seed:** Nut 4–5 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST; Qld, Vic.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Pearl Beach, West Head, Dee Why, Frenchs Forest, Centennial Park (1896), Oatley, Helensburgh. **CT:** Wentworth Falls.

### Habitat

**Habitat:** Shaded slopes, ridgetops.
**Altitude:** 0–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Heath e.g. with *Eucalyptus stricta, Leptospermum trinervium, Melaleuca nodosa, Darwinia fascicularis;* woodland e.g. with *Corymbia gummifera, Eucalyptus obstans, Banksia serrata.*
**Substrate:** Sandy soil on sandstone, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Mainly restricted to coast with the only Tablelands record for Wentworth Falls (1915, 1985). Conservation status unknown. Reported in Brisbane Water NP, Ku-ring-gai Chase NP, Royal NP.

## *Schoenus maschalinus* CYPERACEAE

### Life history

**Growth form:** Small, loosely mat-forming perennial herb; flowering stems 4–20 cm long.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire(D. Keith pers. comm.).
**Fire response:** Resprouts (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST; Qld, Vic., Tas., S.A., W.A., N.Z., Marianas, Malesia.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Linden, Centennial Park, La Perouse, Kogarah, Marley Lagoon, Thirlmere, Darkes Forest. **CT:** Blackheath, Wentworth Falls, Mt Werong, Hill Top, Barrengarry Mountain.

### Habitat

**Habitat:** Damp to swampy places, waterfalls, margins of swamps, cliff faces.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Swamp e.g. with *Melaleuca quinquenervia, Viminaria juncea, Phragmites australis.*
**Substrate:** Sandy soil on sand, sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Sydney Harbour NP, Royal NP.

## *Schoenus melanostachys* CYPERACEAE

### Life history

**Growth form:** Perennial herb, with stems arising from short stout rhizome, often forms large weeping tussocks; flowering stems 30–125 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** September–February.
**Fruit/seed:** Nut 2 mm long.
**Dispersal, establishment & growth:** No special morphology for dispersal (Westoby et al. 1990).
**Fire response:** Resprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), fruiting in 1 year (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Qld, Vic., Borneo.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Linden, Hornsby, Cheltenham, Balmoral Beach, Randwick, Kogarah, Waterfall, Helensburgh, Austinmer, Cambewarra, Bomaderry. **CT:** Lithgow, Mt Wilson, Blackheath, Wentworth Falls, Kangaloon, Carrington Falls, Fizroy Falls, Wingello.

### Habitat

**Habitat:** Wetland, gullies, cliffs, creeks.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Open-forest e.g. with *Eucalyptus piperita;* cliff edges e.g. with *Epacris crassifolia, Allania endlicheri, Leptospermum polygalifolium.*
**Substrate:** Sandy soils on sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Marramarra NP, Muogamarra NR, Garigal NP, Dalrymple Hay NR, Lane Cove NP.

## *Schoenus moorei* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with flowering stems 7–22 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–November.
**Fruit/seed:** Nut 1–2 mm long.
**Dispersal, establishment & growth:**
**Fire response:** Stems killed, resprouts from base. Fruiting in 1 year after high intensity fire 1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:** Stems eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC CT ST NWS CWS; ?Vic.
**Distribution Sydney area:** Coast and Upper Blue Mountains.
**Select locations:** **CC:** Cowan, Berowra, West Head, Mona Vale, Frenchs Forest, Northbridge, Centennial Park, Kogarah, Voyagers Point, Minto, Douglas Park. **CT:** Lithgow, Bell, Mt Wilson, Leura.

### Habitat

**Habitat:** Ridges, plateaus.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Allocasuarina nana, Eucalyptus stricta, Angophora hispida;* woodland e.g. with *Eucalyptus parramattensis, Melaleuca decora.*
**Substrate:** Sandy soils on sandstone, Tertiary alluvium, periodically wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Ku-ring-gai Chase NP, Garigal NP, Royal NP.

## *Schoenus nitens* CYPERACEAE

### Life history

**Growth form:** Small perennial herb, with slender creeping rhizome; flowering stems 3–37 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** September–October.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC ST; Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Coastal estuaries.
**Select locations:** **CC:** Frenchs Forest, Dee Why, La Perouse, Sandringham, Little Salt Pan Creek, Bass Point.

### Habitat

**Habitat:** Damp areas behind beaches or near brackish soaks further inland.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Estuarine sedgeland e.g. with *Juncus kraussii, Baumea juncea, Melaleuca ericifolia;* rocky areas e.g. with *Apium prostratum, Isolepis cernua, Isolepis nodosa;* wet heath.
**Substrate:** Sandy soils on sand, sandstone, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Schoenus paludosus* CYPERACEAE

### Life history

**Growth form:** Tufted annual herb, with flowering stems 5–15 cm long.
**Vegetative spread:** No.
**Longevity:** Less than 1 year. Indefinite (D. Keith pers. comm.).
**Primary juvenile period:** Less than 1 year.
**Flowers:** March–May.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Qld.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** **CC:** Somersby, Mooney Mooney, Bowens Creek, West Head, Cowan, Belrose, Randwick, La Perouse, Kurnell, Loftus, Darkes Forest, Bulli Pass, Mt Ousely, Cataract Dam. **CT:** Lawson.

### Habitat

**Habitat:** Damp places.
**Altitude:** 0–800 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Gymnoschoenus sphaerocephalus, Empodisma;* wet heath e.g. with *Banksia oblongifolia, Banksia ericifolia;* woodland e.g. with *Eucalyptus sieberi, E. piperita.*
**Substrate:** Sandy soils on sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Mainly coast and with one old record (Lawson 1905) in the Blue Mountains. Conservation status unknown. Reported in Brisbane Water NP, Muogamarra NR, Garigal NP, Sydney Harbour NP, Royal NP.

## *Schoenus turbinatus* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with erect, rigid flowering stems14–40 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–February.
**Fruit/seed:** Nut 1–2 mm long.
**Dispersal, establishment & growth:** Possibly ant-dispersed (Rice & Westoby 1981)
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT; Vic., Tas.
**Distribution Sydney area:**
**Select locations:** **CC:** Cheltenham, La Perouse, Springwood, Appin, Mt Ousley. **CT:** Newnes Junction, Hartley, Mt Wilson, Blackheath, Leura, Lawson, Mt Werong, Robertson.

### Habitat

**Habitat:** Rocky ridges.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath and scrub e.g. with *Eucalyptus stricta, Banksia ericifolia;* woodland e.g. with *Eucalyptus sparsifolia, Corymbia gummifera.*
**Substrate:** Sandy soils on sandstone, low nutrients, well-drained.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP.

## *Schoenus villosus* CYPERACEAE

### Life history

**Growth form:** Tufted perennial herb, with erect flowering stems 15–40 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** January–August.
**Fruit/seed:** Nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:** Stems killed, resprouts from base; conspicuous after fire. Flowers mature 15 months after high intensity fire 1/1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC CT ST; Qld.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Howes Valley, Kariong, East Kurrajong, Springwood, Hornsby, Darkes Forest. **CT:** Mt Darcy, Newnes Junction, Clarence, Mt Wilson, Blackheath, Lawson, Hill Top, Robertson.

### Habitat

**Habitat:** Moist sites, margins of swamps.
**Altitude:** 0–1000 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Angophora hispida, Banksia oblongifolia, Ptilothrix deusta, Schoenus imberbis;* woodland e.g. with *Eucalyptus sieberi, Corymbia gummifera, Eucalyptus mannifera, E. radiata.*
**Substrate:** Sandy soils on sandstone, low nutrients, damp sites.
**Exposure:**

### Conservation

**Conservation:** Reported in Brisbane Water NP, Royal NP.

## *Scirpus polystachyus* CYPERACEAE

### Life history

**Growth form:** Robust, tufted perennial herb, with short, stout rhizome; stems 50–200 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Pale yellow-brown nut 1 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC SC NT CT ST; Qld, Vic.
**Distribution Sydney area:** Oberon area.
**Select locations:** **CT:** Running Stream, Oberon, Edith, Jenolan Caves, Boyd Plateau.

### Habitat

**Habitat:** Creeks, swampy areas.
**Altitude:** 1000–1300 m **Annual rainfall:** 900–1100 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Restio australis, Empodisma minus;* riparian vegetation e.g. with *Leptospermum, Carex appressa, Blechnum.*
**Substrate:** Alluvial soil, low to medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Kanangra Boyd NP.

## *Scleria mackaviensis* CYPERACEAE

### Life history

**Growth form:** Slender perennial herb, with very short rhizome; flowering stems scabrous, 5–30 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** February–April.
**Fruit/seed:** Nut, February–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT NWS CWS; Qld, N.Cal.
**Distribution Sydney area:** Mainly Western Sydney and Illawarra.
**Select locations:** **CC:** Mt Druitt, Casula, Werong Beach, Mount Annan, Razorback, Albion Park, Thirlmere, Coaldale, Coolangatta Mountain. **CT:** Goodmans Ford.

### Habitat

**Habitat:** Rocky slopes, outcrops.
**Altitude:** 0–600 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, E. tereticornis, E. crebra, Bursaria spinosa, Themeda australis, Allocasuarina verticillata;* margins of dry rainforest e.g. with *Guioa semiglauca, Streblus brunonianus, Aphanopetalum resinosum.*
**Substrate:** Clay soils on shale, latite, medium nutrients, dry, well-drained.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown. Reported from Royal NP.

## *Tetraria capillaris* CYPERACEAE

### Life history

**Growth form:** Loosely tufted perennial herb, with slender rhizome; flowering stems 18–60 cm long.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** October.
**Fruit/seed:** Nut 2 mm long, October.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST; Qld, Vic., Tas., S.A., W.A., N.Z.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Bilpin, Windsor, Galston, Bayview, Duffys Forest, Lane Cove, Blaxland, Darkes Forest, Mt Keira, Jamberoo, Barrengarry Mountain. **CT:** Blackheath.

### Habitat

**Habitat:** Ridges, creeks.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Corymbia eximia, Angophora costata, Eucalyptus sparsifolia, Banksia ericifolia;* heath e.g. with *Banksia robur.*
**Substrate:** Sandy to clay soils on sandstone, or with shale influence, low nutrients, periodically impeded drainage.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Tricostularia pauciflora* CYPERACEAE

### Life history

**Growth form:** Small tufted perennial herb, with flowering stems 10–45 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** September–November.
**Fruit/seed:** Nut 2 mm long, November–December.
**Dispersal, establishment & growth:** Ant-adapted food body for dispersal (Westoby et al. 1990).
**Fire response:** Fruiting 2 years after high intensity fire 1/1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Vic., Tas., S.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Hornsby, Frenchs Forest, Manly, Woodford, La Perouse, Cronulla, Otford, Mt Keira. **CT:** Kanangra Walls.

### Habitat

**Habitat:** Ridgetops.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Leptospermum polygalifolium, Petrophile pulchella, Allocasuarina distyla, Caustis flexuosa, Corymbia gummifera.*
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Ku-ring-gai Chase NP, Garigal NP, Royal NP, Kanangra Boyd NP.

## *Uncinia tenella* CYPERACEAE

### Life history

**Growth form:** Small densely-tufted perennial herb, with very slender rhizome; stems to 15 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–December.
**Fruit/seed:** Yellow-brown to grey-brown nut 3 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic., Tas.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** **CT:** Mt Wilson, Katoomba, Lawson.

### Habitat

**Habitat:** Creek beds, moist cliffs.
**Altitude:** 700–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Rainforest e.g. with *Ceratopetalum apetalum, Elaeocarpus holopetalus, Dicksonia antarctica.*
**Substrate:** Sandy soil on sandstone, alluvium, low to medium nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Rare, restricted to Upper Blue Mountains. Conservation status unknown.

## *Dioscorea transversa* DIOSCOREACEAE

### Life history

**Growth form:** Climber, with annual twining stems 2–4 m long and cylindrical, pale-coloured, tuber or 'yam' usually less than 10 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Male and female flowers on different plants, greenish, September.
**Fruit/seed:** Papery, 3-lobed capsule 20–30 mm long, with flat, winged seeds 5 mm long, October.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Tuber or 'yam', may be eaten raw but usually roasted or boiled, popular food amongst Aboriginal people (Wightman & Andrews 1991).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT; Qld, N.T.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Cooranbong, Morisset, Mandalong, Ourimbah Creek, Gosford, Bayview, Manly, Stanwell Park.

### Habitat

**Habitat:** Creekbanks.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Gallery rainforest; moist forest e.g. with *Eucalyptus saligna, E. paniculata, Angophora floribunda.*
**Substrate:** Sandy to clay soils on alluvium, shale, sandstone, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Regionally rare in Illawarra region (Mills 1988), conservation status elsewhere unknown. Stanwell Tops is southern geographical limit.

## *Doryanthes excelsa* DORYANTHACEAE

### Life history

**Growth form:** Giant rosette plant with numerous basal, sword-shaped leaves.
**Vegetative spread:** Possible subterranean branching following fire (Denham & Auld 2002), shoots from base forming 3–4 rosettes in the bush or often about 10 in cultivation, with a few flowering each year (P. Vaughan, Gumnuts 44, 2002).
**Longevity:** 5–10 years in cultivation (Rymer 1983, Elliot & Jones 1984), much long in the wild (A. Denham pers. comm.).
**Primary juvenile period:** 7 years (P. Vaughan, Gumnuts 44, 2002).
**Flowers:** Red, June–December.
**Fruit/seed:** Red-brown capsule 7–10 cm long, taking more than 12 months to mature (Nash 1996), mature March–June, with disc-like seeds, 15 mm diam., 2 mm thick, approx. weight 43 mg (Denham & Auld 2002).

**Dispersal, establishment & growth:** No special dispersal morphology (Westoby et al. 1990), wind-dispersed to 7 m, no dormancy; following fire (in Royal NP 1994) germination began after 2.5 years (Denham & Auld 2002), survival of seedlings after 5.5 years is more than 50% (A. Denham pers. comm.).

**Fire response:** Resprouts, with plants taking 19 months to flower from apical buds protected in underground leaf bases (after fire 1994 in Royal NP); fire appears to stimulate a single post-fire flowering event, following which individuals undergo subterranean branching, also flowers sporadically in absence of fire (Denham & Auld 2002).
**Interaction with other organisms:** Post dispersal seed predation probably by Swamp Wallaby *Wallabia bicolor* and Rusa Deer as well as *Rattus fuscipes* and invertebrates (Denham & Auld 2002).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC.
**Distribution Sydney area:** Somersby, Georges River to Bulli.
**Select locations:** **CC:** Somersby, Calga, Canoelands, Kentlyn, Audley, Woronora River, Menai, Maddens Plains, Darkes Forest, Bulli Pass.

### Habitat

**Habitat:** Hillsides, plateaus.
**Altitude:** 0–200 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Eucalyptus open-forest, woodland e.g. with *Angophora costata, Eucalyptus piperita, E. sieberi, Corymbia gummifera.*
**Substrate:** Sandy, clayey soils derived from sandstone, often with ironstone influence, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Bulli is southern geographical limit. Reported in Brisbane Water NP, Royal NP.

## *Eriocaulon scariosum* ERIOCAULACEAE

### Life history

**Growth form:** Small tufted herb.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November, peak December.
**Fruit/seed:** Capsule.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST CWS; Qld, Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Howes Valley, Agnes Banks, Yarramundi, Balgowlah, Watsons Bay, Centennial Park, Coogee, Canterbury (1893), Kogarah (1893), La Perouse, Loftus, Thirlmere. CT: Currant Mountain Gap, Running Stream, Ben Bullen, Wingello.

### Habitat

**Habitat:** Bogs, drainage areas, running water.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Heath e.g. with *Banksia ericifolia, Hakea teretifolia;* swamp woodland e.g. with *Eucalyptus parramattensis, Melaleuca decora;* soaks e.g. with *Gonocarpus, Lobelia alata, Xyris, Utricularia.*
**Substrate:** Sandy soil on sandstone, alluvium, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Flagellaria indica* FLAGELLARIACEAE

### Life history

**Growth form:** Perennial climber with robust, bamboo-like stems to 15 m high and 10 mm diam. and numerous thick, fleshy roots.
**Vegetative spread:** Often forms dense thickets.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Numerous fragrant white flowers, spring–autumn.
**Fruit/seed:** Fleshy greenish-red fruit 5 mm diam., usually with 1 seed, October.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Host to butterfly Larger Darter *Telicota anisodesma* (Jones & Gray 1988). An important plant for ceremonial purposes amongst Aboriginal people, used for armbands, rope, fibre for baskets, fruit eaten when it turns pink, also used for medicinal purposes (Wightman & Andrews 1991), stems can be tapped for water (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; LHI, Qld, N.T., W.A., Pac.Is., Asia, E Afr.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Point Clare, Bola Creek.

### Habitat

**Habitat:** Creekbanks.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Gully rainforest, moist eucalypt forest e.g. with *Eucalyptus pilularis.*
**Substrate:** Sandy clay on alluvium, shales, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Rare, Royal NP is southern geographical limit. Conservation status unknown.

## *Haemodorum corymbosum* HAEMODORACEAE

### Life history

**Growth form:** Herb to 70 cm high, with terete leaves; bulbous rootstock with orange-red pigment.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Brown or black in terminal clusters. Flowers abundantly only after fire (Keith 1996), October–January, peak December.
**Fruit/seed:** 3-lobed capsule 7–12 mm long, with flat, winged seeds, December–April.
**Dispersal, establishment & growth:** Wind-dispersed (Westoby et al. 1990). Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resprouts, secondary juvenile period 2 years (D. Keith pers. comm.).
**Interaction with other organisms:** Leaves on some plants eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC ST.
**Distribution Sydney area:** Coast.
**Select locations:** CC: Agnes Banks, Narrabeen, Beacon Hill, Manly, Maroubra, Waterfall, Darkes Forest, Barrengarry.

### Habitat

**Habitat:** Swampy areas, sandstone plateaus, hillsides.
**Altitude:** 0–200 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Angophora costata, Eucalyptus piperita, E. sclerophylla, Banksia serrata;* heath e.g. with *Angophora hispida, Allocasuarina distyla.*
**Substrate:** Dry and swampy sandy soil on sandstone, dune sand, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Restricted to coastal Sydney with inland population at Agnes Banks near Richmond. Conservation status unknown. Reported in Royal NP.

## *Haemodorum planifolium* HAEMODORACEAE

### Life history

**Growth form:** Herb to 1.3 m high, with flat leaves; bulbous rootstock with orange-red pigment.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Blackish, in terminal clusters. Flowers abundantly only after fire (Keith 1996).
**Fruit/seed:** 3-lobed capsule 5–11 mm long, with flat, winged seeds.
**Dispersal, establishment & growth:**
**Fire response:** Stems killed, resprouts at base or below (Fox 1988 and others), shedding seeds 1 year after high intensity fire 1/1994 (at Lane Cove and Narrabeen, P. Kubiak pers. comm.).
**Interaction with other organisms:** Leaves on some plants eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS; Qld.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Toronto, Charmhaven, Bilpin, Agnes Banks, Shane Park, Glenbrook Lagoon, Commodore Heights, Asquith, Tumbledown Dick, Bondi, La Perouse, Thirlmere, Bargo, Hill Top. CT: Newnes SF, Bell, Mt Hay, Blackheath, Katoomba, Barren Grounds.

### Habitat

**Habitat:** Ridges, hillsides.
**Altitude:** 0–1200 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Corymbia gummifera, Eucalyptus sieberi, E. piperita, E. sclerophylla, Angophora costata;* open-forest e.g. with *Eucalyptus pilularis, Angophora costata, Syncarpia glomulifera, Eucalyptus paniculata,* with grassy understorey; seacliff-top scrub.
**Substrate:** Sandy soil on sandstone, sometimes lateritic or shaley, granite, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Ku-ring-gai Chase NP, Royal NP, Georges River NR.

## *Muscari armeniacum* * HYACINTHACEAE

Common Grape Hyacinth

### Life history

**Growth form:** Erect perennial herb to 45 cm high, with bulb 15–30 mm diam. and fibrous roots.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Scented, dark blue, with paler or white lobes, September–October.
**Fruit/seed:** Capsule 7–9 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to SE Europe, Asia Minor; introduced as ornamental.
**Botanical subregions:** CT ST; Vic., S.A.
**Distribution Sydney area:** Tablelands.
**Select locations:** **CT:** Carcoar Cemetery (1998), Mittagong (1984), Lidsdale (1977).

### Habitat

**Habitat:** Old gardens, cemeteries, roadside.
**Altitude:** 900–1000 m **Annual rainfall:** 900–1000 mm
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Not truly naturalised. Commonly cultivated as ornamental in cooler regions, with record for roadside at Lidsdale.

## *Egeria densa* * HYDROCHARITACEAE

Dense Waterweed

### Life history

**Growth form:** Attached submerged aquatic perennial, stems to 1.5 m long, rooting at lower nodes, with most growth near the surface of stationary or slowly flowing water.
**Vegetative spread:** Thick mat of intertwining stems produced below surface (Parsons & Cuthbertson 1992).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** White, only male flowers recorded in NSW, during warmer months.
**Fruit/seed:** Reproduction in Australia is vegetative only (Parsons & Cuthbertson 1992).
**Dispersal, establishment & growth:** Sole means of dispersal in Australia is by stem fragments; growth commences in spring as water temperature rises above 15°C, with rapid growth continuing until February–March (Parsons & Cuthbertson 1992).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America. Introduced to Australia through aquarium trade (Parsons & Cuthbertson 1992).
**Botanical subregions:** NC CC SC SWS SWP; Qld, Vic., Tas., N.T., W.A.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Lane Cove, North Rocks (1950), Pendle Hill, Liverpool, Audley, Dapto, Shoalhaven Heads.

### Habitat

**Habitat:** Wetlands, creeks, dams.
**Altitude:** 0–200 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** e.g. with other aquatics, *Potamogeton, Vallisneria, Alternanthera.*
**Substrate:** In stationary or flowing fresh water especially where substrate has been disturbed. Mild to warm water at all depths to 7 m (Parsons & Cuthbertson 1992).
**Exposure:**

### Conservation

**Conservation:**

## *Elodea canadensis* * HYDROCHARITACEAE

Elodea, Canadian Pondweed

### Life history

**Growth form:** Submerged aquatic perennial herb; stems to 3 m long, with long thread-like, often reddish roots at lower nodes.
**Vegetative spread:** Horizontal stolons extend the vegetative mat (Parsons & Cuthbertson 1992).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Male flowers November–February (Parsons & Cuthbertson 1992). Female flowers not recorded in Australia (Bowmer et al. 1995).
**Fruit/seed:** Not produced in Australia (Parsons & Cuthbertson 1992).
**Dispersal, establishment & growth:** Diaspore: vegetative dispersal only, stem fragments break readily at nodes with mechanical disturbance or wave action; growth is limited by temperature, new growth in September or October as water temperatures rise above 15°C, with vigorous growth in summer if temperature remains above 25°C, declines in March (Parsons & Cuthbertson 1992). Vigorous coloniser in disturbed areas.
**Fire response:**
**Interaction with other organisms:** Potential biological control agents *Hydrilla* leaf-mining fly and stem boring weevil (Bowmer et al. 1995), European carp aids weed spread by fragmentation (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to N America. Introduced as aquarium ornamental.
**Botanical subregions:** NC CC ST CWS SWS SWP; Qld, Vic., Tas., W.A.
**Distribution Sydney area:** Coastal river systems.
**Select locations:** **CC:** Centennial Park (1973), Yarramundi Lagoon (1994), Warragamba Dam, Wallacia, Nepean River (1994), Shoalhaven River (1988).

### Habitat

**Habitat:** Lagoons, dams.
**Altitude:** 0–100 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** e.g. with *Potamogeton, Vallisneria.*
**Substrate:** Deep, cold, flowing or stationary water, fresh, up to 10 m deep.
**Exposure:** Relatively light-demanding; growth may continue under cover of ice (Bowmer et al. 1995).

### Conservation

**Conservation:** Probably initially introduced through discarded aquaria contents, dispersal is mostly by stem fragments floating downstream, though it is confined to cold water. Agressive aquatic weed that blocks irrigation and drainage channels, difficult to control with herbicide (Bowmer et al. 1995).

## *Halophila decipiens* HYDROCHARITACEAE

Seawrack

### Life history

**Growth form:** Submerged marine perennial herb, with one root at each node of rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Rarely flowers but more likely during warmer months (Harden 1993).
**Fruit/seed:** Fruit 2 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC; Qld, Pac., Indian & Atlantic Oceans.
**Distribution Sydney area:** Coastal estuaries.
**Select locations:** **CC:** Sydney Harbour, Botany Bay, Port Hacking.

### Habitat

**Habitat:** Estuarine or protected marine habitats 2–18 m deep.
**Altitude:** 2–18 m below sealevel. **Annual rainfall:** —
**Typical local abundance:**
**Vegetation:**
**Substrate:** Usually on sand, not exposed at low tide.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Halophila ovalis* HYDROCHARITACEAE

Seawrack

### Life history

**Growth form:** Submerged marine aquatic, perennial herb; rhizomes to 3 mm diam. and 1 or 2 roots at each node.
**Vegetative spread:** Creeping rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Rarely flowers but more likely during warmer months (Harden 1993).
**Fruit/seed:** Berry-like 5–10 mm long, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; LHI, Qld, Vic., Tas., N.T., S.A., W.A., Pac. & Indian Oceans.
**Distribution Sydney area:** Estuaries and coastal lakes.
**Select locations:** **CC:** Lake Macquarie, Brisbane Water, Wagstaff, Pittwater, Clontarf, Balmoral, Watsons Bay, Parsley Bay, Kogarah Bay, Towra, Quibray Bay, Port Hacking.

### Habitat

**Habitat:** Estuarine or protected marine habitats to 5 m deep, lake margins.
**Altitude:** 0–5 m below sea level. **Annual rainfall:** —
**Typical local abundance:** Occasional.
**Vegetation:** Seagrass meadows e.g. with *Posidonia* and *Zostera*.
**Substrate:** Sand or mud, rarely exposed at low tide.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Hydrilla verticillata* HYDROCHARITACEAE

Hydrilla, Water Thyme

### Life history

**Growth form:** Attached, branched submerged aquatic perennial herb with stems to 2 m long and axillary turions and tubers. Does not develop aerial leaves (Cook & Lüönd 1982).
**Vegetative spread:** Stoloniferous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Funnel-like, close to the surface of the water, with lower part underwater while open to the air above, pollinated by aerial transport of pollen (Cook & Lüönd 1982).
**Fruit/seed:** Fruit 7 mm long, with 2–6 seeds 2–3 mm long. Produces seed from monoecious plants but reproduces mainly from vegetative propagules (Spencer et al. 1994).
**Dispersal, establishment & growth:** Growth rarely limited by water quality; vegetative dispersal by detached stem fragments that readily form new plants and attach to substrate (Cook & Lüönd 1982).
**Fire response:**
**Interaction with other organisms:** Foodplant of Black Swan *Cygnus atratus* (Barker & Vestjens 1989,1990).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NWS CWS SWS SWP SFWP; Qld, Vic., N.T., S.A., W.A., Asia, Afr.
**Distribution Sydney area:** Hawkesbury-Nepean River, coastal swamps.
**Select locations:** **CC:** Upper Colo, Wisemans Ferry, Richmond, Centennial Park, East Lakes, Macquarie Fields, Chipping Norton, Bents Basin.

### Habitat

**Habitat:** Rivers, lakes.
**Altitude:** 0–100 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** e.g. with *Najas, Potamogeton.*
**Substrate:** Freshwater, still to flowing, 30–100 cm deep. Rarely in swiftly-flowing water; found in acidic oligotrophic to eurotrophic water, tolerates strongly alkaline and brackish water (Cook & Lüönd 1982).
**Exposure:** Avoids shady habitats (Cook & Lüönd 1982).

### Conservation

**Conservation:**

## *Ottelia ovalifolia* HYDROCHARITACEAE

Swamp Lily

### Life history

**Growth form:** Tufted aquatic perennial or annual with submerged and floating leaves.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White or coloured, November–January.
**Fruit/seed:** Indehiscent, 25–40 mm long, enclosed in a bladder-like sac, with numerous seeds, withdraws into the water as it matures (Harden 1993).
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP; Qld, Vic., N.T., S.A., W.A.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Tuggerah, Pitt Town, Luddenham, Springwood, Faulconbridge, Lane Cove River, Penrith, Cabramatta, Mount Annan. **CT:** Berrima.

### Habitat

**Habitat:** Waterholes, creeks, dams in stationary or moving water to 1 m deep.
**Altitude:** 0–500 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** e.g. with *Juncus usitatus, Elatine gratioloides.*
**Substrate:** Clay soils on alluvium, shale, medium nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Hypoxis hygrometrica* var. *hygrometrica* HYPOXIDACEAE

Golden Weather-grass

### Life history

**Growth form:** Perennial herb with a cylindrical corm 12–40 mm long and fleshy to fibrous roots;
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, October–January.
**Fruit/seed:** Capsule 2–5 mm long, with dark brown to black seeds 2 mm wide.
**Dispersal, establishment & growth:** No particular mechanism for dispersal (McIntyre et al. 1995). Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Resptouts, secondary juvenile period 1 year (D. Keith pers. comm.).
**Interaction with other organisms:** Rhizomes eaten by Aboriginal people (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS; Vic., Tas., S.A.
**Distribution Sydney area:** Coast and Western Blue Mountains.
**Select locations: CC:** Ryde, Darkes Forest, Bulli. **CT:** Jenolan Caves, Oberon, Katoomba.

### Habitat

**Habitat:** Moist sites, hanging swamp.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Occasional.
**Vegetation:** Moist sedgeland, open-woodland e.g. with *Eucalyptus sclerophylla.*
**Substrate:** Sandy loam on sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conserved status unknown. Reported in Kanangra Boyd NP.

## *Hypoxis hygrometrica* var. *villosisepala* HYPOXIDACEAE

### Life history

**Growth form:** Perennial herb, with corm 12–40 mm long; roots fleshy-fibrous, more or less tuberous.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Bright yellow, sporadic, August–January.
**Fruit/seed:** Capsule 2–5 mm long, with dark brown to black seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS SWS; Qld, Vic.
**Distribution Sydney area:** Mainly Western Sydney.
**Select locations: CC:** Pitt Town, Tempe, Lansdowne, Mount Annan, Mt Kembla.
CT: Ganguddy Creek.

### Habitat

**Habitat:** Moist sites.
**Altitude:** 0–800 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, E. crebra, E. fibrosa.*
**Substrate:** Sandy clay on shale, alluvium, medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Hypoxis pratensis* var. *pratensis* HYPOXIDACEAE

Golden Weather-grass

### Life history

**Growth form:** Perennial herb, with corm less than 15 mm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, November–March.
**Fruit/seed:** Capsule 3–7 mm long, with dark brown to black seeds 1 mm diam., February–April.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT CWS; Qld.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Richmond, Hornsby, Emerton, Rooty Hill, Stanwell Park, Kangaroo Valley, Berry. **CT:** Glanmire.

### Habitat

**Habitat:** Moist sites, grassy hillsides.
**Altitude:** 0–800 m **Annual rainfall:** 800–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus longifolia, E. fibrosa, Melaleuca decora.*
**Substrate:** Clay soils on shale, alluvium, volcanic necks, medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Hypoxis pratensis* var. *tuberculata* HYPOXIDACEAE

### Life history

**Growth form:** Perennial herb, with corm less than 15 mm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, summer to autumn.
**Fruit/seed:** Capsule 3–7 mm long, with dark brown to black seeds 1 mm diam.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC; Qld, Vic.
**Distribution Sydney area:** Western Sydney.
**Select locations:** **CC:** Richmond (1905), Picton (1998).

### Habitat

**Habitat:** Moist sites, near creeks.
**Altitude:** 0–300 m **Annual rainfall:** 800 mm
**Typical local abundance:** Rare.
**Vegetation:** Woodland e.g. with *Eucalyptus crebra, E. eugenioides, E. baueriana.*
**Substrate:** Clay soils on shale, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Rare, only one recent NSW record from Picton in 1998. Otherwise only known from Richmond (1905).

## *Hypoxis vaginata* var. *brevistigmata* HYPOXIDACEAE

### Life history

**Growth form:** Perennial herb, with corm less than 12 mm long
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, spring.
**Fruit/seed:** Capsule 8–14 mm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CT SWS; Vic., Tas.
**Distribution Sydney area:** Abercrombie Caves.
**Select locations:** CT: Abercrombie Caves (1951).

### Habitat

**Habitat:** Damp sites.
**Altitude:** 600–800 m **Annual rainfall:** 800 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Rare, only Sydney area record and northern geographical limit is Abercrombie Caves, collected in 1951.

## *Aristea ecklonii* * IRIDACEAE

### Life history

**Growth form:** Herb to 70 cm high, with woody rhizome; leaf bases usually red.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Bright blue and green, opening for a few hours only, September–November.
**Fruit/seed:** Capsule 20 mm long, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:** Resprouted after high intensity fire 1/1994 (at Narrabeen), fruiting in 11 months (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S and tropical W Africa.
**Botanical subregions:** CC.
**Distribution Sydney area:** Northern Sydney.
**Select locations:** CC: McCarrs Creek (1990), Deep Creek (1992).

### Habitat

**Habitat:** Disturbed woodland, roadside.
**Altitude:** 0–200 m **Annual rainfall:** 1100–1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** Woodland e.g. with *Eucalyptus gummifera*.
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Recently reported (1990–92) spreading locally on roadsides and near creeks in northern Sydney. Probably spread from dumped garden waste. Potential for spread unknown.

## *Babiana stricta* * IRIDACEAE

### Life history

**Growth form:** Perennial herb 12–40 cm high, with corms and annual leaves and flowers.
**Vegetative spread:** Probably spread from corms.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Purple to blue, September–October.
**Fruit/seed:** Capsule with numerous seeds.
**Dispersal, establishment & growth:** Vegetative dispersal (Carr et al. 1992) by corms.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa, introduced as ornamental.
**Botanical subregions:** NC CC; ?Vic., S.A., W.A.
**Distribution Sydney area:** Suburban areas.
**Select locations:** **CC:** St Ives (1989), Balgowlah (1952), Albion Park (1963).

### Habitat

**Habitat:** Roadsides, wasteland, drainage lines.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** *Themeda* grassland.
**Substrate:** Sandy soils on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Cultivated and occasionally locally naturalised, probably originating as dumped garden waste.

## *Chasmanthe floribunda* * IRIDACEAE

### Life history

**Growth form:** Perennial herb 1–1.5 m high, with corm to 6 cm diam; leaves and flowers annual.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Orange-red or yellow, August–December.
**Fruit/seed:** Capsule with a few orange seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Cape Province S Africa. Introduced as ornamental.
**Botanical subregions:** CC; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** East Lakes (1998), Campbelltown (1965).

### Habitat

**Habitat:** Swamp margin.
**Altitude:** 0–200 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Rare.
**Vegetation:**
**Substrate:** Clay, sand.
**Exposure:**

### Conservation

**Conservation:** Cultivated, reported from cemeteries, golf course, but probably from old plantings or garden refuse dumping.

## *Crocosmia* X *crocosmiiflora* * IRIDACEAE

### Life history

**Growth form:** Perennial herb 30–100 cm high, with stolons, and up to 15 corms 20-30 mm diam; annual leaves and flowers.
**Vegetative spread:** Stolons and corms.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Red-orange, January–March.
**Fruit/seed:** Capsule 7–10 mm diam., with about 6 seeds 3 mm long.
**Dispersal, establishment & growth:** Diaspore: vegetative dispersal by corms in dumped garden refuse (Muyt 2001). Apparently not producing viable seed (Harden 1993).
**Fire response:** Probably resprouted after high intensity fire 1/1994 (at Lane Cove and Narrabeen), fruiting in 10 months (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, horticultural hybrid between *C. aurea* and *C. pottsii*, produced in France in 1880 (Harden 1993), introduced as ornamental.
**Botanical subregions:** NC CC SC CT; LHI, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Coast and Blue Mountains.
**Select locations:** **CC:** Glenbrook, Beecroft (1975), Holdsworthy (1964). **CT:** Katoomba (1954), Blackheath (1954), Lawson, Lithgow, Robertson.

### Habitat

**Habitat:** Old gardens, roadsides, moist forest.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Eucalypt woodland.
**Substrate:** Sandy soils on sandstone, shale, alluvium, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Naturalised on coast and particularly in Blue Mountains, where it was first recorded as naturalised 50 years ago.

## *Dierama pendulum* * IRIDACEAE

### Life history

**Growth form:** Tufted perennial herb 1–1.2 m high, with corms.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pink, December–January.
**Fruit/seed:** Papery, 3-lobed capsule 7 mm diam., with few seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa, introduced as ornamental.
**Botanical subregions:** CT; S.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CT:** Wentworth Falls (1958), Moss Vale (1930), Wildes Meadow (1993).

### Habitat

**Habitat:** Roadside, wet ground.
**Altitude:** 600–1000 m **Annual rainfall:** 900–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Roadside woodland remnants.
**Substrate:** Sandy soils on alluvium.
**Exposure:** Full sun.

### Conservation

**Conservation:** Reported occasionally naturalised from garden escapes near Robertson (1993) and Wentworth Falls (Harden 1958).

## *Dierama pulcherrimum* * IRIDACEAE

### Life history

**Growth form:** Tufted perennial herb 1–1.2 m high, with corms 3–4 cm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Dark pink to purple-red, October–November.
**Fruit/seed:** Papery, 3-lobed capsule, with few seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CT.
**Distribution Sydney area:**
**Select locations:** **CC:** Ingleburn (1936).

### Habitat

**Habitat:**
**Altitude:** 0–200 m **Annual rainfall:** 800–900 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Moist, well-drained soils.
**Exposure:** Full sun.

### Conservation

**Conservation:** Only one record from Ingleburn 1936, doubtfully naturalised.

## *Freesia* * hybrid IRIDACEAE

### Life history

**Growth form:** Perennial herb 10–40 cm high, with annual leaves and flowers; corms 15 mm diam., bulbils in lower leaf axils.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to cream with yellow, August–October.
**Fruit/seed:** Capsule 10–15 mm diam., with 3–4 brown to black seeds.
**Dispersal, establishment & growth:** Vegetative spread by corms and bulbils e.g. in dumped garden refuse.
**Fire response:** Probably resprouted after high intensity fire 1/1994 (at Lane Cove), fruiting in 10 months (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC; Vic., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Gosford (1969).

### Habitat

**Habitat:** Roadsides, wasteland.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Occasionally naturalised after dumping of garden refuse, though records from cemeteries would be from old graveside plantings.

## *Gladiolus angustus* * IRIDACEAE

### Life history

**Growth form:** Perennial herb 20–60 cm high, with annual leaves and flowers; corms to 15 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to cream or pinkish, October–December.
**Fruit/seed:** Fruit not seen.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouted after high intensity fire 1/1994 (at Lane Cove and Narrabeen), flowering 10 months later (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa, introduced as ornamental.
**Botanical subregions:** CC; S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Wyee (1953), Somersby (1993), Hurstville (1950).

### Habitat

**Habitat:** Roadsides, drains, vacant land.
**Altitude:** 0–200 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Weedy sites e.g. with *Coreopsis lanceolata, Briza major, Verbena bonariensis.*
**Substrate:** Sandy soil over sandstone, low nutrients, periodically wet.
**Exposure:**

### Conservation

**Conservation:** Occasionally naturalised locally in the Sydney area.

## *Gladiolus carneus* * IRIDACEAE

### Life history

**Growth form:** Perennial herb 35–80 cm high, with annual leaves and flowers; corms 20–30 cm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to pink or lavender, October–November.
**Fruit/seed:** Fruit not seen.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa, introduced as ornamental.
**Botanical subregions:** CC CT; S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Little Bay (1975), Narellan (1965), Shoalhaven (1985). **CT:** Crookwell, Bundanoon.

### Habitat

**Habitat:** Roadsides, riverflats.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:** Clay soils on shale, basalt, alluvium.
**Exposure:**

### Conservation

**Conservation:** Occasionally locally naturalised in Sydney area.

## *Gladiolus gueinzii* *

**IRIDACEAE**

### Life history

**Growth form:** Perennial herb 20–60 cm high, with annual leaves and flowers, bulbils in axils of leaves and underground corms, each with 16–35 cormils at least (Heyligers 1999).

**Vegetative spread:** Some cormils sprout forming a clump of plants around the parent (Heyligers 1999).

**Longevity:** Indefinite.

**Primary juvenile period:**

**Flowers:** Mauve-pink, self-compatible, mainly October–December (Heyligers 1999).

**Fruit/seed:** Capsule 2.5–3.5 cm long, with numerous winged seeds 10 mm long. Seeds shed when capsule matures in summer (Heyligers 1999).

**Dispersal, establishment & growth:** Diaspore: seeds, wind and water-dispersed, as well as vegetative dispersal by cormils, which may float for up to 7 months in seawater (Heyligers 1999).

**Fire response:**

**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.

**Botanical subregions:** NC CC SC.

**Distribution Sydney area:** Coastline.

**Select locations:** CC: The Entrance, Barrenjoey, Narrabeen, Kurnell, Shoalhaven Heads.

### Habitat

**Habitat:** Coastal sand dunes, beaches.

**Altitude:** 0–5 m **Annual rainfall:** 1200–1400 mm

**Typical local abundance:** Frequent–occasional.

**Vegetation:** Pioneer species on foredunes e.g. with *Spinifex hirsutus.*

**Substrate:** Dune sand, low nutrients, well-drained.

**Exposure:**

### Conservation

**Conservation:** First collected near Newcastle in 1950 and has spread 250 km to the north and 500 km to the south (Heyligers 1999).

## *Gladiolus undulatus* *

**IRIDACEAE**

### Life history

**Growth form:** Perennial herb 40–80 cm high, with annual leaves and flowers; corms 20–30 mm diam., with numerous bulbils.

**Vegetative spread:**

**Longevity:**

**Primary juvenile period:**

**Flowers:** White to cream and greenish, November–January, peak December.

**Fruit/seed:** Fruit not seen.

**Dispersal, establishment & growth:**

**Fire response:**

**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.

**Botanical subregions:** NC CC CT SWS; Vic., Tas., S.A., W.A.

**Distribution Sydney area:** Widespread.

**Select locations:** CC: Lower Hawkesbury River, Hornsby, Pennant Hills (1938), Eastwood, Lane Cove River (1917), Middle head, Centennial Park (1911), La Perouse, Leumeah. CT: Carcoar (1998).

### Habitat

**Habitat:** Roadsides, drainage channels.

**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm

**Typical local abundance:** Frequent–occasional.

**Vegetation:**

**Substrate:** Sandy soils on sandstone, sand, shale, low to medium nutrients.

**Exposure:**

### Conservation

**Conservation:** Reported for nearly a century and widely naturalised on coast.

## *Herbertia lahue* subsp. *caerulea* * IRIDACEAE

### Life history

**Growth form:** Perennial herb to 20 cm high, with annual leaves and flowers; bulb 2 cm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pale blue, October–December.
**Fruit/seed:** Capsule 15–20 mm long, with seeds 1–2 mm long, December–January.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to America.
**Botanical subregions:** NC CC.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Gosford (1926), Glenorie, Ryde (1902), Parramatta Park, Blackett, Mount Annan.

### Habitat

**Habitat:** Disturbed sites.
**Altitude:** 0–300 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassland and lawn.
**Substrate:** Clay soils on shale, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Occasionally naturalised.

## *Iris germanica* * IRIDACEAE

Tall Bearded Iris

### Life history

**Growth form:** Clump-forming perennial herb to 120 cm high, with fleshy rhizomes 3–5 cm diam; sword-shaped leaves in fan-shaped clusters.
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** White or blue, violet, yellow or multicoloured, September–October.
**Fruit/seed:** Capsule 4–5 cm long, with numerous wrinkled brown seeds 5 mm diam.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe and W Asia, introduced as ornamental.
**Botanical subregions:** CC ST NWS CWS; Vic., Tas., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Kembla Grange (1921), Camden (1965).

### Habitat

**Habitat:** Roadsides, wasteland.
**Altitude:** 0–300 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Clay soils on shale, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Widely cultivated, occasionally naturalised locally.

## *Ixia flexuosa* * *(I. columellaris)* IRIDACEAE

### Life history

**Growth form:** Perennial herb 30–55 cm high, with corm 10–13 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White or pale mauve to pink, November–December.
**Fruit/seed:** Capsule with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC; Tas.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Maroubra (1954), Narellan (1966), Bargo (1953).

### Habitat

**Habitat:** Disturbed sites, roadsides, sandhills.
**Altitude:** 0–300 m **Annual rainfall:**
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:** Clay or sandy soils.
**Exposure:**

### Conservation

**Conservation:** Occasionally naturalised in Sydney area.

## *Libertia paniculata* IRIDACEAE

### Life history

**Growth form:** Perennial herb, with rhizomes.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White, September–November.
**Fruit/seed:** Black capsule 5–8 mm diam., with numerous dark brown seeds 1 mm diam.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT; Qld, Vic.
**Distribution Sydney area:** Coast and Blue Mountains.
**Select locations:** **CC:** Boorai Ridge, Grose River, Otford. **CT:** Galah Mountain, Blackheath, Moorara Boss, McMahons Lookout, Mount Murray.

### Habitat

**Habitat:** Slopes of moist gullies, sometimes near sea.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1800 mm
**Typical local abundance:** Frequent.
**Vegetation:** Tall open-forest e.g. with *Eucalyptus fastigata, E. deanei, Syncarpia glomulifera, Eucalyptus botryoides* with mesic understorey; gully rainforest e.g. with *Ceratopetalum apetalum.*
**Substrate:** Sandy loam from shale, basalt, granite, fertile. Water table mostly high, moisture supply intermittent, fresh.
**Exposure:** Indifferent to exposure–sheltered; light shade.

### Conservation

**Conservation:** Conservation status unknown. Reported in Wollemi NP, Blue Mountains NP.

## *Libertia pulchella* IRIDACEAE

### Life history

**Growth form:** Perennial herb with rhizomes.
**Vegetative spread:** Stoloniferous, probably capable of spreading.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Cream-white, November–January
**Fruit/seed:** Brown capsule 3–5 mm diam., with numerous dark brown seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC NT CT; Vic., Tas. N.G., N.Z.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** **CC:** Mount Tomah. **CT:** Wentworth Falls.

### Habitat

**Habitat:** Moist gullies, wet rock faces, falls splash zone.
**Altitude:** 500–1000 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** In Sphagnum moss on rock faces in gully rainforest e.g. with *Blechnum, Bauera rubioides.*
**Substrate:** Sandstone boulders and rock faces. Infertile soil. Water table permanently high, moisture supply continuous, fresh.
**Exposure:** Sheltered situations; deep–mid shade.

### Conservation

**Conservation:** Restricted local occurrences in Sydney area, conservation status unknown.

## *Moraea collina* * *(Homeria collina)* IRIDACEAE

Cape Tulip

### Life history

**Growth form:** Perennial herb to 35 cm high, with annual leaves and flowers; corms 12–18 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pale yellow or salmon pink, August–September.
**Fruit/seed:** Cylindrical capsule 3–4 cm long, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC SC SWS; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Penrith area.
**Select locations:** **CC:** Penrith (1903), Mulgoa (1908), Wallacia (1923).

### Habitat

**Habitat:** Disturbed sites.
**Altitude:** 0–200 m **Annual rainfall:** 800 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Reported naturalised in Penrith area 1900–1925.

## ***Moraea flaccida*** * *(Homeria flaccida)* **IRIDACEAE**

One-leaved Cape Tulip

### Life history

**Growth form:** Perennial herb 25–60 cm high, with annual leaves and flowers; corms 20 mm diam.
**Vegetative spread:** 1–3 new corms produced above the old corm each year (Parsons & Cuthbertson 1992).
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** Salmon orange or yellow, September–October.
**Fruit/seed:** Cylindrical capsule 2.5–5.5 cm long, with numerous seeds.
**Dispersal, establishment & growth:** Diaspore: seed, dispersed as contaminant of agricultural produce, on machinery and feet of animals, in animal droppings; vegetative spread by corms e.g. in gravel for roadmaking; seeds not long-lived in soil, germinate in autumn more readily on surface than when buried; corms dormant during adverse conditions, stimulated by rain and high soil temperature (Parsons & Cuthbertson 1992).
**Fire response:**
**Interaction with other organisms:** Poisonous to cattle, sheep and goats, all parts of the plant toxic whether green or dry (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** NC CC SC NWS SWS; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations: CC:** North Head (1986), Punchbowl (1951), Wollongong (1948).

### Habitat

**Habitat:** Waste places.
**Altitude:** 0–300 m **Annual rainfall:** 1000–1200 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:** Wide range of soil types (Parsons & Cuthbertson 1992).
**Exposure:** Does not establish well on shaded sites (Parsons & Cuthbertson 1992).

### Conservation

**Conservation:** Occasionally naturalised. Control by repeated cultivation at the most susceptible time of year, June–July, for at least 4 years to exhaust the supply of dormant corms (Parsons & Cuthbertson 1992).

## *Moraea ochroleuca* * *(Homeria ochroleuca)* IRIDACEAE

### Life history

**Growth form:** Perennial herb 40–70 cm high, with annual leaves and flowers; corms 20 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, sometimes with orange centre, September–November.
**Fruit/seed:** Cylindrical capsule 2–4 cm long, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC SWS SWP; Vic., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** CC: Rydalmere (1945).

### Habitat

**Habitat:**
**Altitude:** 0–200 m **Annual rainfall:** 1000 mm
**Typical local abundance:**
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Locally serious weed south from Sydney district (Harden 1993), with only Sydney record at Rydalmere in 1945, where it was reported to be widespread on hospital grounds, evidently spread by cultivation.

## *Patersonia fragilis* IRIDACEAE

### Life history

**Growth form:** Tufted, glabrous, perennial herb to 50 cm high, with woody rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Violet to blue-violet, October–January.
**Fruit/seed:** Cylindrical capsule 25–30 mm long; seeds 2 mm long, black, glossy, with a white aril, January–February.
**Dispersal, establishment & growth:** Diaspore: seed, with ant-adapted food body for dispersal.
**Fire response:**
**Interaction with other organisms:** Food plant of butterfly larvae *Mesodina halyzia halyzia* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC SC NT CT ST; Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Tablelands.
**Select locations:** CT: Clarence, Dingo Swamp, Warlock Ridge.

### Habitat

**Habitat:** Wet heath.
**Altitude:** 1000–1200 m **Annual rainfall:** 1000–1200 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Shrub swamp e.g. with *Leptospermum grandifolium, Grevillea acanthifolia, Empodisma minus;* moist heath.
**Substrate:** Peaty to sandy soil on sandstone, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown, reported in Kanangra Boyd NP.

## *Patersonia glabrata* IRIDACEAE

### Life history

**Growth form:** Subshrub 30–80 cm high, with woody rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pale violet, August–October, peak September. Small beetles seen feeding destructively on flower (P. Kubiak pers. comm.).
**Fruit/seed:** Cylindrical capsule 20–40 mm long; seeds 4 mm long, brown, glossy, with a white aril, October–March. Viability of fresh seed 84% (Vigilante et al. (1998).
**Dispersal, establishment & growth:** Diaspore: seed, with ant-adapted food body for dispersal (Westoby et al. 1990, Rice & Westoby 1981).
**Fire response:** Resprouts at base or below (Fox 1988, Vigilante et al. (1998), fruiting and shedding seeds in 1 year; flowering more prolific in 2nd year after fire (P. Kubiak pers. comm.).
**Interaction with other organisms:** Food plant of butterfly larvae *Mesodina halyzia halyzia* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT CWS; Qld.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Putty, Gosford, Colo Heights, Windsor, Bilpin, Cheltenham, Frenchs Forest, Centennial Park, Canterbury, Waterfall, Berry. **CT:** Gospers Mountain, Clarence, Wentworth Falls, Kanangra, Wombeyan.

### Habitat

**Habitat:** Plateaus, hillsides.
**Altitude:** 0–1100 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus sieberi, Corymbia gummifera, Corymbia eximia, Eucalyptus sparsifolia;* open-forest e.g. with *Angophora costata, Eucalyptus globoidea, E. notabilis;* coastal heath e.g. with *Angophora hispida, Banksia obongifolia.*
**Substrate:** Sandy clay on shaley sandstone, laterite, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Brisbane Water NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Sydney Harbour NP.

## *Patersonia longifolia* IRIDACEAE

### Life history

**Growth form:** Perennial tufted herb to 60 cm high, with woody rhizome.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Blue-violet, at any time, peak October–December.
**Fruit/seed:** Capsule 15–25 mm long, with cylindrical seeds 3 mm long.
**Dispersal, establishment & growth:** Diaspore: seed, adapted for ant-dispersal (Rice & Westoby 1981).
**Fire response:** Stems killed, resprouts from base.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST; Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Howes Valley, Bilpin, Springwood, Wisemans Ferry, Berowra, Rookwood. **CT:** Clarence, Katoomba, Hill Top, Penrose SF.

### Habitat

**Habitat:**
**Altitude:** 0–1100 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Eucalypt open-forest e.g. with *Eucalyptus sieberi, E. sclerophylla, Angophora costata, Corymbia gummifera, Eucalyptus radiata, E. mannifera;* heath e.g. with *Eucalyptus stricta, Leptospermum trinervium, Angophora hispida.*
**Substrate:** Sandy soil on sandstone, occasionally on shale, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Patersonia sericea* IRIDACEAE

### Life history

**Growth form:** Densely tufted perennial herb to 60 cm high, with woody rhizome.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** Blue-violet, August–March, peak September
**Fruit/seed:** Capsule 15–30 mm long; seeds 3 mm long, cylindrical, brown, with waxy bloom, without aril; seed weight 5 mg (Westoby et al. 1982), September–December.
**Dispersal, establishment & growth:** Diaspore: seed, with ant-adapted food body for dispersal (Westoby et al. 1990, Rice & Westoby 1981). Recruitment mainly after fire (D. Keith pers. comm.).
**Fire response:** Stems killed, resprouts from base. Seeds shed almost 1 year following high intensity fire 1/1994 (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:** Leaves sometimes eaten by rabbits (P. Kubiak pers. comm.). Food plant of butterfly larvae *Mesodina halyzia halyzia, M. aeluropis* (Common & Waterhouse 1981).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS; Qld, Vic.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Putty, Doyalson, Kariong, Maraylya, Agnes Banks, Berkshire Park, Hornsby, Cheltenham, Frenchs Forest, Roseville, Kogarah, Waterfall, Audley, Douglas Park, Cataract Dam, Bargo, Fitzroy Falls, Bomaderry. **CT:** Mt Coricudgy, Clarence, Lithgow, Katoomba, Lawson, Wombeyan, Robertson.

**Habitat**

**Habitat:** Ridges, plateaus.
**Altitude:** 0–1100 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Open-forest e.g. with *Eucalyptus sieberi, Corymbia gummifera, E. radiata, E. dives, E. piperita, Angophora costata;* woodland e.g. with *Eucalyptus sclerophylla, E. haemastoma, E. pauciflora, E. mannifera, Angophora bakeri, Corymbia eximia;* heath e.g. with *Angophora hispida, Banksia serrata.*
**Substrate:** Sandy soil on sandstone, low nutrients.
**Exposure:**

**Conservation**

**Conservation:** Probably adequately conserved. Reported in Wollemi NP, Brisbane Water NP, Marramarra NP, Muogamarra NR, Ku-ring-gai Chase NP, Garigal NP, Sydney Harbour NP, Royal NP.

## ***Romulea rosea*** **var.** ***australis*** * IRIDACEAE

**Life history**

**Growth form:** Small perennial herb, with roundish corm, without an aerial stem; leaves basal.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow and pale to bright pink or rarely white, August–November.
**Fruit/seed:** Cylindrical capsule 10 mm long, with numerous seeds, September–November.
**Dispersal, establishment & growth:** Growth period spring, dies down after flowering.
**Fire response:** Probably reprouted after high intensity fire 1994 (at Lane Cove and Narrabeen), flowering after 9 months (P. Kubiak pers. comm.).
**Interaction with other organisms:** Purple Swamphens *Porphyrio porphyrio* feed on corms in autumn and winter (Diez & Clarke 1996).

**Distribution**

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** NC CC SC CT ST NWS CWS SWS SWP; LHI, Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Richmond (1906), Mosman, Parramatta, RBG (1898), Cooks River (1912), Mount Annan, Narellan (1916), Menangle Park, Pt Kembla. **CT:** Carcoar.

**Habitat**

**Habitat:** Pastures, lawns, roadsides.
**Altitude:** 0–900 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Grassland, lawns.
**Substrate:** Clay soils on shale, alluvium, medium nutrients.
**Exposure:**

**Conservation**

**Conservation:** A common weed of pastures, lawns and roadsides, recorded for over a century.

## *Sisyrinchium iridifolium* * IRIDACEAE

Blue Pigroot

**Life history**

**Growth form:** Grass-like annual or perennial herb 10–60 cm high, with rhizomes.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** White to cream with purple or blue centre, October–November.
**Fruit/seed:** Brown capsule 3–8 mm diam, with numerous dark brown seeds 1 mm diam., November–January.
**Dispersal, establishment & growth:**
**Fire response:** Possibly killed by high intensity fire 1/1994 (at Lane Cove and Narrabeen), fruiting 10 months later (P. Kubiak pers. comm.).
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to S America and Mexico.
**Botanical subregions:** CC SC CT; Qld, Vic., Tas., S.A.
**Distribution Sydney area:** Widespread on coast and Southern Highlands.
**Select locations:** CC: Hornsby, Carlton (1895), Kangaroo Valley, Unanderra. CT: Wingecarribee Swamp, Bowral, Berrima, Marulan.

**Habitat**

**Habitat:** Gardens, waste ground, swamp margins.
**Altitude:** 0–700 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Grassy heathland, swamp margins; open-woodland e.g. with *Eucalyptus sclerophylla.*
**Substrate:** Sandy to clay loam on shales, medium nutrients, periodically moist.
**Exposure:**

**Conservation**

**Conservation:** Weed of gardens, waste ground and rough pasture.

## *Sisyrinchium* species *A* * *(S. micranthum)* IRIDACEAE

**Life history**

**Growth form:** Tufted annual herb 5–20 cm high. Uncertain taxonomy.
**Vegetative spread:**
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** Pale yellow, with brown-purple markings in centre, or blue to mauve with a yellowish throat, October–December.
**Fruit/seed:** Capsule 2–4 mm diam., with numerous black, pitted seeds.
**Dispersal, establishment & growth:**
**Fire response:** Possibly killed by high intensity fire 1/1994 (at Lane Cove and Narrabeen), fruiting 10 months later (P. Kubiak pers. comm.).
**Interaction with other organisms:** Reported toxic to stock.

**Distribution**

**Status/origin:** Exotic, native to S America.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS; LHI, Qld, Vic., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Wyong, Gosford (1893), Linden, Richmond (1925), Cheltenham, St Marys (1888), Cooks River (1912), Homebush (1892), Macquarie Fields, Campbelltown, Albion Park, Wollongong, Berry (1941). CT: Currant Mountain Gap.

**Habitat**

**Habitat:** Pastures, roadsides, drainage ditches.
**Altitude:** 0–800 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Grassland, pastures.
**Substrate:** Sandy soils, low nutrients, periodically wet.
**Exposure:**

**Conservation**

**Conservation:** Widely naturalised since 1880s.

## *Sparaxis bulbifera* * IRIDACEAE

Harlequin Flower

### Life history

**Growth form:** Perennial herb 15–55 cm high, with annual leaves and flowers; corms 10–15 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Yellow, September–November.
**Fruit/seed:** Capsule 10 mm long, with numerous seeds 2 mm diam.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** CC CT; Vic., S.A., W.A.
**Distribution Sydney area:** Leura.
**Select locations:** **CT:** Gordon Falls Reserve (2000).

### Habitat

**Habitat:** Roadsides, wasteland.
**Altitude:** 900–1000 m **Annual rainfall:** 1400 mm
**Typical local abundance:** Rare.
**Vegetation:** Revegetation area e.g. with *Allium triquetrum, Myosotus sylvatica, Anthoxanthum odoratum.*
**Substrate:** Silty sand on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** One recent record for Leura in 2000, probably garden escape but potential to spread unknown.

## *Tritonia lineata* * IRIDACEAE

Lined Tritonia

### Life history

**Growth form:** Perennial herb 30–60 cm high, with annual leaves and flowers; corms to 20 mm diam.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Cream, September–October.
**Fruit/seed:** Capsule with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC CT SWS; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Suburban areas.
**Select locations:** **CC:** Cooranbong, Gosford (1946), Cheltenham (1941), Roseville, Curl Curl, Malabar, Rookwood, Albion Park, Nowra (1943). **CT:** Lawson, Hazelbrook (1950).

### Habitat

**Habitat:** Disturbed sites, grassland, dry slopes.
**Altitude:** 0–800 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassland e.g. with *Themeda australis;* scrub e.g. with *Acacia longifolia, Banksia aemula.*
**Substrate:** Sandy to clay soils on sand, shale, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Locally naturalised since 1940s on vacant land and remnant of old gardens, sometimes in bushland remnants.

## ***Watsonia borbonica*** **subsp.** ***ardernei*** ***** *(W. pyramidata)* **IRIDACEAE**

**Life history**

**Growth form:** Perennial herb to 2 m high, with annual leaves and flowers; corms 3–4 cm diam.
**Vegetative spread:** Corms.
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pink to light purple, September–November.
**Fruit/seed:** Woody capsule 3 cm long.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** CC CT; Vic., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Cooranbong (1978), Helensburgh (1996). **CT:** Hazelbrook (1998).

**Habitat**

**Habitat:** Ridgetops.
**Altitude:** 0–800 m **Annual rainfall:** 1100–1600 mm
**Typical local abundance:** Occasional.
**Vegetation:** Eucalypt woodland.
**Substrate:** Clay soil, low nutrients.
**Exposure:**

**Conservation**

**Conservation:** A few recent records though not clear whether truly naturalised.

## ***Watsonia meriana*** cv. ***bulbillifera*** ***** *(W. angusta)* **IRIDACEAE**

Wild Watsonia, Bugle Lily

**Life history**

**Growth form:** Perennial herb 1–2 m high, with annual leaves and flowers; corms 4–8 cm diam.
**Vegetative spread:** Corms.
**Longevity:** Indefinite. Parts above ground level died off within 1 year after resprouting (at Lane Cove, P. Kubiak pers. comm.).
**Primary juvenile period:**
**Flowers:** Orange to red, rarely pink or purple, October.
**Fruit/seed:** Capsule not seen.
**Dispersal, establishment & growth:** Spread by seed and vegetatively from bulbils on flowering stem and corms dumped in garden waste (EWAN).
**Fire response:** Probably resprouted after high intensity fire 1/1994 (at Lane Cove and Narrabeen), flowering 10 months later; bulbils shed about 1 year after fire (at Lane Cove, P. Kubiak pers. comm.).
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Exotic, native to S Africa. Introduced as ornamental.
**Botanical subregions:** NC CC SC CT ?NWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Central Mangrove (1974), Mt Colah (1973), North Turramurra (1960), Rookwood (1973), La Perouse (1975), Heathcote (1966). **CT:** Lawson (1982).

**Habitat**

**Habitat:** Roadsides, slopes, creeks.
**Altitude:** 0–800 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:**
**Substrate:** Sandy to clayey soils on sands, shale, low to medium nutrients.
**Exposure:**

**Conservation**

**Conservation:** Locally naturalised since 1960s, probably spreading from old garden plantings or garden waste dumping. Spreading locally by corms.

## *Juncus acuminatus* *

**JUNCACEAE**

### Life history

**Growth form:** Tufted or shortly rhizomatous perennial herb, with flowering stems 25–60 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Occasionally proliferates from flowers.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to N and C America.
**Botanical subregions:** NC CC CT NWS; Tas.
**Distribution Sydney area:** Royal NP, Southern Highlands.
**Select locations:** **CC:** Audley, Hacking River (1973), Bola Creek, Woronora River. **CT:** Wildes Meadow, Belmore Falls (1976).

### Habitat

**Habitat:** Swamps, drains.
**Altitude:** 0–700 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sedgeland e.g. with *Juncus effusus, Juncus sarophus, Juncus procerus, Lycopus australis, Restio tetraphyllus.*
**Substrate:** Sandy soils on alluvium, medium nutrients, permanently wet.
**Exposure:**

### Conservation

**Conservation:** Naturalised for at least 30 years, ability to spread unknown.

## *Juncus acutiflorus* *

**JUNCACEAE**

### Life history

**Growth form:** Perennial herb, with short rhizome and flowering stems 20–110 long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe, NW Africa, SW Asia.
**Botanical subregions:** CT.
**Distribution Sydney area:** Wentworth Falls.
**Select locations:** **CT:** Wentworth Falls (1991).

### Habitat

**Habitat:** Swamp.
**Altitude:** 800–1000 m **Annual rainfall:** 1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swamp e.g. with *Leptospermum, Juncus articulatus, Juncus microcephalus, Juncus effusus.*
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Naturalised in swampy area at Central Park, Wentworth Falls (recorded 1991, 1992, 1993). Ability to spread is unknown.

## *Juncus acutus* subsp. *acutus* * JUNCACEAE

### Life history

**Growth form:** Tussock-forming perennial herb, with short rhizome and flowering stems 30–160 cm long.
**Vegetative spread:** Rhizomatous, short distance.
**Longevity:**
**Primary juvenile period:** 2–3 years (Parsons & Cuthbertson 1992).
**Flowers:** July–December.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet. Seeds 1 mm long, with papery appendages, germinate at most times of the year (Parsons & Cuthbertson 1992).
**Dispersal, establishment & growth:** Diaspore: seed or capsules, water-dispersed, contaminant of agricultural produce, in mud and on machinery; also vegetative dispersal by rhizomes through soil movement (Parsons & Cuthbertson 1992).
**Fire response:**
**Interaction with other organisms:** Establishment along waterways may prevent stock gaining access to water and provides habitat for vermin e.g. rabbits (Parsons & Cuthbertson 1992).

### Distribution

**Status/origin:** Exotic, native to Europe, Mediterranean region, SW Asia.
**Botanical subregions:** NC CC SC NT ST CWS SWS SWP SFWP; Vic., S.A., W.A.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** CC: Bilpin (1958), Brooklyn, Belrose, Watsons Bay, Villawood, Concord, Bankstown (1909), Botany, Leppington.

### Habitat

**Habitat:** Tidal flats, saline areas, roadsides.
**Altitude:** 0–700 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus moluccana, E. tereticornis;* saltmarsh.
**Substrate:** Clay soils on shale, alluvium. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Appears to be spreading in last 30 years. Control by mechanical removal of plants (Parsons & Cuthbertson 1992).

## *Juncus alexandri* subsp. *melanobasis* JUNCACEAE

### Life history

**Growth form:** Perennial herb, with rhizomes; flowering stems 70–150 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–October.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC NT CT.
**Distribution Sydney area:** Mt Coricudgy.
**Select locations:** CT: Mt Coricudgy, Kerry Mountain.

### Habitat

**Habitat:** Depressions.
**Altitude:** 1000–1200 m **Annual rainfall:** 1000 m
**Typical local abundance:** Occasional.
**Vegetation:** Moist eucalypt forest and rainforest.
**Substrate:** Clay soil on alluvium, basalt, medium to high nutrients.
**Exposure:**

### Conservation

**Conservation:** Mt Coricudgy is southern geographical limit. Conservation status unknown.

## *Juncus amabilis* JUNCACEAE

### Life history

**Growth form:** Perennial herb with short rhizomes and flowering stems 50–110 cm long.
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** December.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic in CC, but native to other parts of Australia.
**Botanical subregions:** *CC SWS SWP SFWP; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Flemington (1969), Leightonfield (1993).

### Habitat

**Habitat:** Damp places, railway yard, saleyards.
**Altitude:** 0–200 m **Annual rainfall:** 900–1000 mm
**Typical local abundance:** Occasional.
**Vegetation:** Depression with *Casuarina glauca.*
**Substrate:** Clay soil on shale, medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Native to Western NSW, probably introduced to Sydney region with stock.

## *Juncus aridicola* JUNCACEAE

### Life history

**Growth form:** Perennial herb with short rhizomes and soft grey-green flowering stems 55–115 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–November.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native in CT but introduced to CC.
**Botanical subregions:** *CC CT NWS CWS SWS NWP SWP NFWP SFWP; *LHI, Qld, Vic., N.T., S.A., W.A.
**Distribution Sydney area:**
**Select locations:** **CC:** Rookwood Cemetery (1973), Flemington Saleyards (1968), Villawood (1988). **CT:** Megalong Valley (1963).

### Habitat

**Habitat:** Wet places.
**Altitude:** 0–600 m **Annual rainfall:** 900–1000 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus sclerophylla, E. sideroxylon, Angophora floribunda.*
**Substrate:** Clay soil on shale, alluvium, medium nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Native to western NSW but probably introduced to Sydney area with stock.

## *Juncus articulatus* * JUNCACEAE

### Life history

**Growth form:** Perennial herb, with short rhizomes; flowering stems to 60 cm long.
**Vegetative spread:** Roots at nodes.
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Germination in all seasons in Northern Tablelands (Britton & Brock 1994).
**Fire response:** Resprouted after high intensity fire 1/1994 (at Lane Cove), flowering 10 weeks later (P. Kubiak pers. comm.).
**Interaction with other organisms:** Foodplant of Black Swan *Cygnus atratus* (Barker & Vestjens 1989,1990).

### Distribution

**Status/origin:** Exotic, native to Europe, Asia, N Africa, N America.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Mellong Swamp, Wisemans Ferry, Cowan Creek (1915), Beecroft, Middle Harbour, Carlingford, Parsley Bay, Bondi (1883), Kogarah (1901), Woolooware Bay, Campbelltown, Stanwell Park, O'Hares Creek, Nepean Dam, Berry. **CT:** Ilford, Nashdale, Katoomba, Boyd Crossing, Wombeyan Caves, Wingecarribee Swamp, Fitzroy Falls.

### Habitat

**Habitat:** Moist places, creeks, ponds.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Wetland vegetation e.g. with *Juncus* species, *Eleocharis* species, *Persicaria* species.
**Substrate:** Sandy soil on sand, alluvium, sandstone, granite, low to medium nutrients, permanently moist. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** Introduced by 1900 and now widely naturalised in damp situations.

## *Juncus australis* JUNCACEAE

### Life history

**Growth form:** Strongly rhizomatous perennial herb, with flowering stems 50–100 cm long.
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–April, peak February–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Diaspore mobile (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST NWS CWS SWS; Vic., Tas., S.A., N.Z.
**Distribution Sydney area:** Mainly Tablelands.
**Select locations:** **CC:** Bilpin, Kurrajong Heights, Mt Kembla. **CT:** Hill End, Ganguddy Creek, Orange, Mt Wiagdon, Mt Canobolas, Blackmans Flat, Glanmire, Georges Plains, Wolgan Gap, Little Hartley, Megalong Valley, Blackheath, Sunny Corner, Blayney, Oberon, Wentworth Falls, Yerranderrie, Burraga, Taralga, Hill Top, Mittagong, Wingecarribee Swamp.

### Habitat

**Habitat:** Seasonally wet places, slopes, creekbanks.
**Altitude:** 500–1400 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassland, woodland e.g. with *Eucalyptus viminalis, Eucalyptus sparsifolia, E. pauciflora, E. melliodora, E. blakelyi, E. bridgesiana, E. aggregata, E. ovata.*
**Substrate:** Clay soil on alluvium, slates, rhyolite, shale, sandstone, low to high nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Winburdale NR.

## *Juncus bufonius* * (*J. plebeius*) JUNCACEAE

Toad Rush

### Life history

**Growth form:** Tufted annual herb. Culms terete 2–20 cm long; leaves basal and cauline, shorter than culms.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** Often fertilised within unopened flower (cleistogamous), at any time of year, peak October–December.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet. Seed weight 0.01 mg (Shipley & Parent 1991).
**Dispersal, establishment & growth:** Diaspore mobile (McIntyre et al. 1995), dispersed in mud on cars (Wace 1977). Germination in all seasons in Northern Tablelands (Britton & Brock 1994), 20% within 30 days (Shipley & Parent 1991). Coloniser.
**Fire response:** Fruiting 38 weeks after high intensity fire 1/1994 (at Narrabeen, P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to temperate regions.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS SWP NFWP; LHI, Qld, Vic., Tas., N.T., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wyong Creek, Richmond, Oxford Falls, Castlecove, Dennistone, Domain (1902), Kogarah (1899), Glenfield, Tahmoor, Waterfall (1895), Mt Keira, Upper Kangaroo Valley, Bomaderry. **CT:** Ilford, Molong Creek, Orange, Katoomba, Hartley, Jenolan Caves (1899), Boyd River.

### Habitat

**Habitat:** Disturbed sites, creeks.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassland, woodland e.g. with *Eucalyptus pauciflora, E. rubida.*
**Substrate:** Sandy soils on sandstone, low nutrients, periodically moist. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

### Conservation

**Conservation:** First recorded over a century ago, now widely naturalised.

## *Juncus bulbosus* * JUNCACEAE

### Life history

**Growth form:** Tufted perennial herb, with slightly bulbous bases; flowering stems to 30 cm long, often with proliferation from inflorescence.
**Vegetative spread:** Rooting from nodes.
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–May.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Growth stimulated by high carbon dioxide levels combined with high ammonium concentration (Roelofs et al. 1994).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, Native of NW Africa, Europe, Iceland, Greenland & Newfoundland
**Botanical subregions:** CC SC CT ST; Vic., Tas., S.A.
**Distribution Sydney area:** Mainly Upper Blue Mountains.
**Select locations:** **CC:** Glenbrook Lagoon, Marley Lagoon. **CT:** Lithgow, Clarence (1919, 1961), Mt Wilson (1951), Wentworth Falls, Wingecarribee Swamp.

### Habitat

**Habitat:** Wet places.
**Altitude:** 0–1200 m **Annual rainfall:** 1000–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Creekbank e.g. with *Juncus planifolius;* lagoon edge e.g. with *Lepyrodia muelleri, Baumea juncea;* heath e.g. with *Allocasuarina nana, Leptospermum trinervium.*
**Substrate:** Sandy soils on sandstone, alluvium, low nutrients, moist, sometimes inundated.
**Exposure:**

### Conservation

**Conservation:** Naturalised in wet situations, particularly on Tablelands.

## *Juncus caespiticius* JUNCACEAE

### Life history

**Growth form:** Tufted or shortly rhizomatous perennial herb, with flowering stems 20–55 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** December–March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC; Vic., Tas., S.A., W.A., N.Z.
**Distribution Sydney area:** Coast.
**Select locations:** **CC:** Lake Munmorah, La Perouse, Kurnell, Garie Beach, Werrong Beach.

### Habitat

**Habitat:** Damp places, creekbanks, behind saltmarsh, sand dunes.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Swampy areas e.g. with *Isolepis nodosa, Ranunculus inundatus, Lomandra longifolia.*
**Substrate:** Sandy soil, on sand dunes, alluvium, low nutrients, fresh water.
**Exposure:**

### Conservation

**Conservation:** Lake Munmorah is northern geographical limit. Conservation status unknown. Reported in Royal NP.

## *Juncus canadensis* * JUNCACEAE

### Life history

**Growth form:** Tufted perennial herb, with flowering stems 40–65 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** March.
**Fruit/seed:** Smooth, shiny capsule, with numerous tailed seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to N America.
**Botanical subregions:** CT.
**Distribution Sydney area:** Wentworth Falls.
**Select locations:** CT: Jamieson Creek, Wentworth Falls (1965).

### Habitat

**Habitat:** Damp situations, along creeks, tracks.
**Altitude:** 800–900 m **Annual rainfall:** 1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Sclerophyll forest e.g. with *Leptospermum, Hakea, Eucalyptus;* along creek above falls.
**Substrate:** Sandy soil on sandstone, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Locally naturalised in bushland at Wentworth Falls (recorded 1965, 1971, 1972, 1975, 1980, 1991, 1993). Ability to spread further unknown.

## *Juncus capensis* * JUNCACEAE

### Life history

**Growth form:** Tufted, shortly rhizomatous perennial herb, with flowering stems 20–50 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S Africa.
**Botanical subregions:** CC.
**Distribution Sydney area:** Eastern suburbs.
**Select locations:** CC: Centennial Park (1901), Eastlakes, Botany Bay (1908), La Perouse.

### Habitat

**Habitat:** Swampy areas.
**Altitude:** 0–100 m **Annual rainfall:** 1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swampy disturbed areas e.g. with *Lantana camara, Acetosa sagittata;* scrub e.g. with *Kunzea ambigua.*
**Substrate:** Sandy soil on sand, sandstone, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Naturalised in Eastern Suburbs for over a century.

## *Juncus capillaceus* * JUNCACEAE

### Life history

**Growth form:** Shortly rhizomatous perennial herb, with flowering stems to 25 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** All year, peak March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America.
**Botanical subregions:** NC CC ; Vic.
**Distribution Sydney area:** Suburban areas.
**Select locations:** **CC:** Marsfield, Pennant Hills, Northbridge (1962), Lane Cove, Homebush (1952), Moorebank, La Perouse (1953), Sutherland, Bundeena, Waterfall.

### Habitat

**Habitat:** Riverbanks, pastures, lawns.
**Altitude:** 0–200 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassy areas, lawns.
**Substrate:** Sandy soils on sandstone, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Weed in pastures, naturalised for at least 50 years.

## *Juncus capitatus* * JUNCACEAE

### Life history

**Growth form:** Tufted annual herb, with flowering stems to 12 cm long.
**Vegetative spread:** No.
**Longevity:** Less than 1 year.
**Primary juvenile period:** Less than 1 year.
**Flowers:** October–November.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe, Mediterranean region, E Africa.
**Botanical subregions:** CC NT CT ST NWS CWS SWS SWP; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Cheltenham, St Marys, Rookwood, Cabarita, Glenfield, Oatley (1903), La Perouse, Menangle, Dapto (1948). **CT:** Oberon (1952), Berrima (1996).

### Habitat

**Habitat:** Creeks, moist sites.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassland, heath e.g. with *Banksia ericifolia, Melaleuca nodosa.*
**Substrate:** Clay soils on shale, sandy soils on sandstone, low–medium nutrients, moist sites.
**Exposure:**

### Conservation

**Conservation:**

## *Juncus cognatus* * JUNCACEAE

### Life history

**Growth form:** Tufted to shortly rhizomatous perennial herb, with flowering stems 25–65 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time, peak January–March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America.
**Botanical subregions:** NC CC SC NT CT NWS.
**Distribution Sydney area:** Mainly coastal.
**Select locations:** CC: Dora Creek, Wyong Creek, Kincumber, Cowan, Londonderry, Cheltenham, Castlecove (1951), Cabarita, Nielsen Park, Centennial Park (1953), Cooks River, Towra Point, Malabar, La Perouse, Campbelltown, Maianbar, Stanwell Park (1954), Bulli Pass, Coomonderry Swamp. CT: Blackheath, Hill Top, Belmore Falls.

### Habitat

**Habitat:** Creekbanks, roadsides.
**Altitude:** 0–800 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Swamps e.g. with *Melaleuca decora, Melaleuca linariifolia;* moist forest.
**Substrate:** Sandy soil on sandstone, alluvium, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** First recorded about 50 years ago and now widely naturalised.

## *Juncus continuus* JUNCACEAE

### Life history

**Growth form:** Rhizomatous perennial, flowering stems 35–115 cm long, with continuous pith. Forms hybrids with *Juncus usitatus, J. australis.*
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time, peak December–January.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Coloniser of disturbed sites (e.g. bulldozed sites).
**Fire response:** Resprouted after high intensity fire 1/1994 (at Narrabeen), flower buds 42 weeks later (P. Kubiak pers. comm.).
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP; Qld, Vic., ? *S.A., N.T.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Howes Valley, Dora Creek, Ourimbah, Mountain Lagoon, Agnes Banks, Asquith, Cheltenham, Glenbrook, Dennistone, Bradleys Head, Kogarah, Salt Pan Creek, La Perouse, Waterfall, Nepean Dam, Wollongong, Coomonderry Swamp. **CT:** Orange, Mt Darcy, Cullen Bullen, Wolgan Gap, Clarence, Mt Wilson, Blackheath, Boyd River, Mt Werong, Wombeyan Caves, Hill Top, Belmore Falls, Bundanoon.

### Habitat

**Habitat:** Edge of swamps, creeks, disturbed sites.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1600 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swamp forest e.g. with *Melaleuca linariifolia, Melaleuca nodosa;* open-forest e.g. with *Eucalyptus piperita, Angophora costata;* heath e.g. with *Angophora hispida, Allocasuarina distyla, Banksia ericifolia;* woodland e.g. with *Eucalyptus cinerea, E. dives, E. rossii.*
**Substrate:** Sandy soils on sandstone, sand, basalt, volcanic necks, low to high nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Juncus effusus* * JUNCACEAE

### Life history

**Growth form:** Shortly to strongly rhizomatous perennial herb, with flowering stems 30–100 cm long.
**Vegetative spread:** Rhizomatous.
**Longevity:**
**Primary juvenile period:**
**Flowers:** December–May.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, January–April.
**Dispersal, establishment & growth:** Seed weight 0.01 mg, germination 61% within 30 days (Shipley & Parent 1991).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to Europe, Asia, Africa.
**Botanical subregions:** CC CT ST; Vic., Tas., S.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Casula (1991), Hacking River (1975). **CT:** Bowenfels, Clarence, Blackheath (1965), Leura (1967), Wildes Meadow.

### Habitat

**Habitat:** Damp sites, swamps, creeks.
**Altitude:** 0–1100 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Gymnoschoenus sphaerocephalus, Gahnia sieberiana, Empodisma minus;* open-forest e.g. with *Eucalyptus sieberi, E. piperita.*
**Substrate:** Sandy to peaty soils on sandstone, alluvium, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** First reported at Blackheath in 1965 and now widespread, mainly in Upper Blue Mountains.

## *Juncus falcatus* JUNCACEAE

### Life history

**Growth form:** Rhizomatous perennial herb, with flowering stems 10–35 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic., Tas., N Amer., N Asia.
**Distribution Sydney area:** Tablelands.
**Select locations:** **CT:** Kanangra Walls, Mt Werong, Ruby Creek.

### Habitat

**Habitat:** High-altitude swamps.
**Altitude:** 1000–1200 m **Annual rainfall:** 1100 mm
**Typical local abundance:** Frequent.
**Vegetation:** Shrub swamp e.g. with *Leptospermum, Empodisma minus, Baloskion australe, Carex gaudichaudiana.*
**Substrate:** Sandy alluvium, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Juncus filicaulis* JUNCACEAE

### Life history

**Growth form:** Slender, shortly rhizomatous perennial herb, with flowering stems 15–45 cm long. Hybridizes with *J. subsecundus* particularly in disturbed situations (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–February.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Diaspore mobile (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST NWS CWS SWS; Vic., Tas., ?W.A.
**Distribution Sydney area:** Bathurst–Taralga area.
**Select locations:** CT: Capertee Valley, Yetholme, Bathurst, Oberon, Marulan, Taralga.

### Habitat

**Habitat:** Creeks, near swamps.
**Altitude:** 600–1000 m **Annual rainfall:** 600–1200 mm
**Typical local abundance:** Occasional–rare.
**Vegetation:** Grassy woodland e.g. with *Eucalyptus viminalis, E. bridgesiana, E. dives;* grassland.
**Substrate:** Clayey, or peaty sandy soil.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Juncus firmus* (*J.* sp. *D2* in Jacobs & Pickard, 1981) JUNCACEAE

### Life history

**Growth form:** Strongly rhizomatous perennial herb, with flowering stems 55–110 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** March–May.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC NT CT NWS CWS; Qld.
**Distribution Sydney area:** Bathurst–Orange area.
**Select locations:** CT: Orange, Bathurst, Sofala, Capertee Valley.

### Habitat

**Habitat:** Creekbank, swampy areas.
**Altitude:** 600–900 m **Annual rainfall:** 600–1000 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swampy area e.g. with *Eleocharis acuta, Typha orientalis, Schoenus apogon;* woodland e.g. with *Eucalyptus melliodora, E. albens, Angophora floribunda.*
**Substrate:** Clay soils on alluvium, seasonally wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Juncus flavidus* JUNCACEAE

### Life history

**Growth form:** Shortly to strongly rhizomatious perennial herb, with flowering stems 25–90 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Coloniser species.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC ?CC NT CT ST NWS CWS SWS NWP SWP SFWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Hornsby, Willoughby, Northbridge, Engadine, Holsworthy, Warumbul, Waterfall. **CT:** Hill End, Nashdale, Cullen Bullen, Mittagong, Marulan.

### Habitat

**Habitat:** Seasonally wet or briefly wet situations, hillsides, vacant land, urban areas.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1300 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus melliodora, E. macrorhyncha, E. dalrympleana, E. bridgesiana, E. viminalis, E. amplifolia, E. radiata.*
**Substrate:** Clay soils on basalt, high nutrients.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Juncus fockei* JUNCACEAE

### Life history

**Growth form:** Tufted or shortly rhizomatous perennial herb, with flowering stems 8–45 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–April, peak December–January.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP; Qld, Vic., Tas.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Richmond, Centennial Park, Glenfield, Narellan. **CT:** Currant Mountain Gap, Orange, Ben Bullen, Clarence, Marrangaroo, Wentworth Falls, Boyd Plateau, Bindook, Hill Top.

### Habitat

**Habitat:** Damp situations, creeks, swamps.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Boggy sedgeland e.g. with *Carex appressa, Carex gaudichaudiana;* scrub e.g. with *Leptospermum obovatum, Leptospermum myrtifolium.*
**Substrate:** Peaty to sandy soil on alluvium, sandstone, granite, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Juncus gregiflorus* JUNCACEAE

### Life history

**Growth form:** Shortly rhizomatous perennial herb, with flowering stems 50–140 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC CT ST; Vic., Tas., W.A.
**Distribution Sydney area:** Mainly Southern Highlands.
**Select locations:** **CC:** Kogarah (1893). **CT:** Bowenfels, Abercrombie River, Mittagong, Bowral, Belmore Falls, Bundanoon, Penrose,

### Habitat

**Habitat:** Stream banks and near swamps.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1100 mm
**Typical local abundance:** Occasional–frequent.
**Vegetation:** Riparian vegetation e.g. with *Juncus subsecundus, Juncus filicaulis, Juncus usitatus, Juncus effusus.*
**Substrate:** Sandy to clay loam and sandstone, alluvium, medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Only one CC record at Kogarah in 1993 and is likely to be extinct there now. Conservation status elsewhere unknown. Bowenfels is northern geographical limit.

## *Juncus holoschoenus* JUNCACEAE

### Life history

**Growth form:** Tufted or shortly rhizomatous perennial herb, with flowering stems 25–75 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Germination in all seasons in Northern Tablelands (Britton & Brock 1994).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC CT ST CWS SWS SWP; Vic., Tas., S.A., W.A., N.Z.
**Distribution Sydney area:** Mainly Tablelands.
**Select locations:** **CC:** Casula, Leppington, Nepean Dam. **CT:** Ilford, Wattle Flat, Mt Werong.

**Habitat**

**Habitat:** Damps soils, ponds, ditches.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1000 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Wet meadow e.g. with *Juncus articulatus;* surrounded by woodland e.g. with *Eucalyptus aggregata, E. bridgesiana, E. viminalis;* wetland edge e.g. with *Typha orientalis, Eleocharis acuta, Eucalyptus amplifolia.*
**Substrate:** Clay soils on alluvium, shale, medium nutrients, periodically inundated. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:**

**Conservation**

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown.

## *Juncus homalocaulis* JUNCACEAE

**Life history**

**Growth form:** Tufted, shortly rhizomatous perennial herb, with flowering stems to 35 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Diaspore mobile (McIntyre et al. 1995). Coloniser of disturbed sites.
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS SWP; Qld, Vic., S.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Mountain Lagoon, Galston, Richmond, Woodford, Cheltenham, Rookwood, Penshurst, Ingleburn, Albion Park, Kangaroo Valley, Cambewarra. **CT:** Upper Cudgegong Valley, Lidsdale, Glanmire, Yerranderie, Fitzroy Falls, Marulan.

**Habitat**

**Habitat:** Moist sites, swamp margins, disturbed sites in suburban areas.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus pauciflora, E. dalrympleana, E. aggregata, E. longifolia, Melaleuca decora;* open-forest e.g. with *Syncarpia glomulifera, Angophora costata.*
**Substrate:** Sandy to clay soil on sandstone, shale, basalt, low to high nutrients.
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown.

## *Juncus imbricatus* * JUNCACEAE

### Life history

**Growth form:** Tufted, shortly rhizomatous perennial herb, with flowering stems 10–45 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–January.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America.
**Botanical subregions:** NC CC SC; Vic., W.A.
**Distribution Sydney area:** North Shore, Shellharbour.
**Select locations:** **CC:** Lindfield, Northbridge (1952), Royal Botanic Gardens (1913), Shellharbour (1949).

### Habitat

**Habitat:** Disturbed situations, roadsides, bush tracks, beaches.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Grassy areas.
**Substrate:** Sandy soil on sandstone, beach sand, well-drained.
**Exposure:**

### Conservation

**Conservation:** Recorded for about 90 years, established in North Shore suburbs, and coast at Shellharbour. Potential for spread unknown.

## *Juncus kraussii* subsp. *australiensis* (*J. maritimus* var. *australiensis*) JUNCACEAE

Sea Rush

### Life history

**Growth form:** Tussock-forming, strongly rhizomatous perennial herb, with flowering stems 40–150 cm long.
**Vegetative spread:**
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** December–June.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet. Seed weight 0.01 mg (Shipley & Parent 1991), December.
**Dispersal, establishment & growth:** Diaspore seed, probably wind-dispersed; seed sinks immediately in tapwater and seawater (Clarke & Hannon 1970). 29 % germination in tapwater and 12 % in 20 % seawater, germination prevented by salinity above 20 % seawater (Clarke & Hannon 1970), 20 % germination within 30 days (Shipley & Parent). Seedling stages showed slight preference for waterlogged conditions and were not adversely affected by freely drained conditions. No salt requirement (Clarke & Hannon 1970)
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic., Tas., N.T., S.A., W.A., N.Z.
**Distribution Sydney area:** Coastal estuaries
**Select locations:** **CC:** Martinsville, Barrenjoey, Bayview, Berowra Creek, Narrabeen, Kogarah, Tempe, Georges Hall, Woolooware Bay, Port Hacking River, Five Islands, Shoalhaven River.

**Habitat**

**Habitat:** Saltmarsh, headlands.
**Altitude:** 0–40 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Dominant–occasional.
**Vegetation:** Saltmarsh e.g. with *Suaeda australis, Sporobolus virginicus,* forming zone more landward than the *Sarcocornia* zone where flooding occurs infrequently and salinity is always much lower than in the *Sarcocornia* zone (Clarke & Hannon 1970). Understorey under *Casuarina glauca.*
**Substrate:** Sandy loam on alluvium, sandstone, medium nutrients, periodically flooded, saline to brackish.
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown. Reported in Sydney Harbour NP.

## *Juncus laeviusculus* subsp. *illawarrensis* JUNCACEAE

(*J.* sp. *D1* in Jacobs & Pickard, 1981)

**Life history**

**Growth form:** Stongly rhizomatous perennial herb, with flowering stems 35–150 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** CC CT ST.
**Distribution Sydney area:** Southern Highlands.
**Select locations:** **CC:** Macquarie Falls, Jamberoo Pass, Foxground. **CT:** Wingecarribee Swamp, Wildes Meadow, Carrington Falls, Bundanoon.

**Habitat**

**Habitat:** Edges of swamps, gullies.
**Altitude:** 0–750 m **Annual rainfall:** 1200–1800 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Moist forest e.g. with *Eucalyptus fastigata, Hedycarya angustifolia, Acacia melanoxylon;* swamp margins e.g. with *Carex gaudichaudiana, Cyperus lucidus, Juncus australis.*
**Substrate:** Clay soils on shale, sandstone, medium to high nutrients, moist.
**Exposure:**

**Conservation**

**Conservation:** Wingecarribee is northern geographical limit. Conservation status unknown.

## *Juncus laeviusculus* subsp. *laeviusculus* JUNCACEAE

(*J.* sp. *D1* in Jacobs & Pickard, 1981)

### Life history

**Growth form:** Stongly rhizomatous perennial herb, with flowering stems 35–150 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–April, peak March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT.
**Distribution Sydney area:** Bathurst–Oberon area.
**Select locations:** CT: Running Stream, Sunny Corner, Gulf Stream, Mt Wilson, Jenolan Caves, Mt Werong.

### Habitat

**Habitat:** Drainage lines, creekbanks, gullies.
**Altitude:** 900–1200 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Moist forest e.g. with *Eucalyptus dalrympleana, E. pauciflora, E. viminalis, E. stellulata, E. ovata, E. radiata.*
**Substrate:** Clay soils on sediments, basalt, alluvium, medium to high nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Mt Werong is southern geological limit, conservation status unknown. Reported in Winburndale NR.

## *Juncus microcephalus* * JUNCACEAE

### Life history

**Growth form:** Tufted or shortly rhizomatous perennial herb, with flowering stems 20–80 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** At any time.
**Fruit/seed:** Smooth shiny red-brown capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Seed weight 0.01 mg, germination 61% within 30 days (Shipley & Parent). Coloniser of disturbed open sites.
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to S America.
**Botanical subregions:** NC CC NT CT; Vic., Tas., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Wyong Creek, Richmond, Asquith, McCarrs Creek (1966), Oxford Falls, Manly, Frenchs Forest (1965), East Lakes, La Perouse (1965), Austinmer. CT: Wentworth Falls.

### Habitat

**Habitat:** Damp, disturbed places, gullies, creeks, ponds.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland e.g. with *Baumea rubiginosa, Juncus* species; open-forest e.g. with *Eucalyptus piperita, Angophora costata.*
**Substrate:** Sandy soils on sand, sandstone, alluvium, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** First recorded in 1965, now widely naturalised on the coast. Potential spread unknown.

## ***Juncus mollis*** (*J.* sp. *X* in Jacobs & Pickard 1981) JUNCACEAE

### Life history

**Growth form:** Shortly to strongly rhizomatous perennial herb, with flowering stems 85–145 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** December–June.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; ?Qld.
**Distribution Sydney area:** Coastal estuaries.
**Select locations:** **CC:** Dora Creek, Budgewoi, Warnervale, Wyong Creek, St Albans, Kincumber, Cattai Creek, Milperra.

### Habitat

**Habitat:** Swamps, creekbanks.
**Altitude:** 0–100 m **Annual rainfall:** 900–1200 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swamp forest e.g. with *Melaleuca quinquenervia, Eucalyptus robusta, Melaleuca linariifolia, Melaleuca decora, Casuarina glauca, Baumea juncea, Baumea articulata, Juncus* species; edge of mangroves with *Juncus kraussii.*
**Substrate:** Clay soils on alluvium, medium nutrients, moist, saline–brackish, seasonally wet situations.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## ***Juncus ochrocoleus*** (*J.* sp. *H* in Jacobs & Pickard 1981) JUNCACEAE

### Life history

**Growth form:** Strongly rhizomatous perennial herb, with flowering stems 35–85 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC NT NWS CWS NWP; Qld.
**Distribution Sydney area:** Howes Valley.
**Select locations:** **CC:** Howes Valley, Wollombi.

### Habitat

**Habitat:** Creekbanks.
**Altitude:** 0–200 m **Annual rainfall:** 800–900 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Riparian vegetation e.g. with *Casuarina cunninghamiana, Eucalyptus tereticornis, E. punctata, Angophora bakeri.*
**Substrate:** Sandy soils on alluvium, low nutrients, seasonally wet.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Juncus pallidus* JUNCACEAE

### Life history

**Growth form:** Tall, strongly rhizomatous perennial herb, flowering stems 70–135 cm long, with continuous pith.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** September–February, peak September.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet, September–June.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC SWP; LHI, Vic., Tas., S.A., W.A., N.Z.
**Distribution Sydney area:** Coast, Broken Bay to Port Hacking.
**Select locations:** **CC:** Curl Curl, Centennial Park, Tempe, Padstow, Rockdale, Malabar, La Perouse, Woolooware Bay, Audley.

### Habitat

**Habitat:** Moist sites.
**Altitude:** 0–200 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Freshwater swamp e.g. with *Eleocharis sphacelata;* adjacent to mangroves e.g. with *Juncus kraussii, Phragmites australis.*
**Substrate:** Sandy soils on deep sand, sandstone, alluvium, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP.

## *Juncus pauciflorus* JUNCACEAE

### Life history

**Growth form:** Slender, shortly rhizomatous perennial herb, shiny flowering stems 15–55 cm long, with continuous pith.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–April, peak April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST; Vic., Tas., S.A., W.A., N.Z.
**Distribution Sydney area:** Mainly Blue Mountains.
**Select locations:** **CC:** Kurrajong Heights, Waterfall, Otford, Macquarie Falls. **CT:** Mt Coricudgy, Mt Wilson, Mount Tomah, Blackheath, Lawson, Jenolan Caves, Boyd River, Yerranderie, Fitzroy Falls.

### Habitat

**Habitat:** Moist situations, creeks, below cliffs, near waterfalls.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1600 mm
**Typical local abundance:** Occasional.
**Vegetation:** Moist open-forest, riparian forest e.g. with *Casuarina cunninghamiana;* swamp margins e.g. with *Leptospermum, Sphagnum.*
**Substrate:** Clay soils on basalt, alluvium, sandstone, granite.
**Exposure:** Mid-shade.

### Conservation

**Conservation:** Conservation status unknown. Reported in Royal NP, Kanangra Boyd NP.

## *Juncus phaeanthus* (*J.* sp. *F* in Jacobs & Pickard, 1981) JUNCACEAE

### Life history

**Growth form:** Shortly to strongly rhizomatous perennial, with flowering stems 30–00 cm high.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Distinctly reddish inflorescence. December–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic.
**Distribution Sydney area:** Boyd Plateau.
**Select locations:** **CT:** Boyd River, Ruby Creek, Dingo Swamp.

### Habitat

**Habitat:** Swampy creeks, swampy flats.
**Altitude:** 1000–1300 m **Annual rainfall:** 1000–2000 mm
**Typical local abundance:** Occasional.
**Vegetation:** Sedgeland e.g. with *Carex iynx, C. inversa, Restio australis.*
**Substrate:** Boggy organic sediments on granite, low nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Blue Mountains NP, Kanangra Boyd NP.

## *Juncus planifolius* JUNCACEAE

### Life history

**Growth form:** Tufted annual or perennial herb, with short vertical rhizome; flowering stems 13–60 cm long, with occasional proliferation from flowers.
**Vegetative spread:**
**Longevity:** Indefinite (D. Keith pers. comm.).
**Primary juvenile period:**
**Flowers:** Numerous, clustered at apex of branches, at any time, peak October–January.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds.
**Dispersal, establishment & growth:** Recruitment mainly after fire (D. Keith pers. comm.). Coloniser.
**Fire response:** Resprouts (D. Keith pers. comm.).
**Interaction with other organisms:** Leaves possibly eaten by rabbits (P. Kubiak pers. comm.).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP; Qld, Vic., Tas., S.A., W.A., N.Z., Chile.
**Distribution Sydney area:** Widespread.
**Select locations:** CC: Woy Woy, Richmond, Galston, Shane Park, Narrabeen, Centennial Park, Castlecove, Neutral Bay, Kogarah, La Perouse, Waterfall, Austinmer, Saddleback Mountain. CT: Currant Mountain Gap, Lithgow, Mt Wilson, Katoomba, Springwood, Boyd River, Mt Werong, Yerranderrie, Hill Top, Paddys River.

### Habitat

**Habitat:** Moist situations, creekbanks, gullies.
**Altitude:** 0–1000 m **Annual rainfall:** 800–1800 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus piperita, Angophora costata, Eucalyptus dalrympleana, E. pauciflora, E. viminalis, Syncarpia glomulifera;* woodland e.g. with *Eucalyptus fibrosa, E. crebra, E. sclerophylla.*
**Substrate:** Sandy to clay soils on sandstone, sand, shale, basalt, low–high nutrients, moist sites.
**Exposure:**

### Conservation

**Conservation:** Widespread and probably adequately conserved. Conserved in Western Sydney (James et al. 1999).

## *Juncus polyanthemus* JUNCACEAE

### Life history

**Growth form:** Shortly to strongly rhizomatous perennial herb, with flowering stems 65–115 cm long. Hybidizes with *J. usitatus* and *J. mollis* especially in cleared wet pastures (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–January.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CWS; Qld, N Cal.
**Distribution Sydney area:** Coastal.
**Select locations:** CC: Dora Creek, Manly Dam, Doonside, Silverwater, Voyager Point, Seven Mile Beach.

**Habitat**

**Habitat:** Swampy situations.
**Altitude:** 0–100 m **Annual rainfall:** 1200–1400 mm
**Typical local abundance:** Occasional.
**Vegetation:** Swamp e.g. with *Melaleuca linariifolia, Eucalyptus amplifolia, Carex appressa;* woodland e.g. with *Eucalyptus sclerophylla, E. parramattensis, E. longifolia, Melaleuca decora, Melaleuca nodosa;* saltmarsh.
**Substrate:** Clay soils on alluvium, shale, medium nutrients, moist.
**Exposure:**

**Conservation**

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Port Kembla is southern geographical limit.

## *Juncus prismatocarpus* JUNCACEAE

**Life history**

**Growth form:** Tufted, annual or perennial herb, flowering stems to 40 cm long; leaves spread along culms, equal or shorter.
**Vegetative spread:** Spreading by rhizome.
**Longevity:** Indefinite.
**Primary juvenile period:**
**Flowers:** November–March.
**Fruit/seed:** Capsule, with numerous seeds, mucilaginous when wet, released at maturity. Seeds 0.5 mm long, 0.2 mm diam. (J. Howell pers. comm.).
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS NWP; Qld, Vic., Tas., S.A., N.Z.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Wyong Creek, Maroota, Cheltenham, Centennial Park, Eastlakes, Liverpool, Londonderry, Appin, Albion Park, Berry. **CT:** Rylstone, Winburndale, Nashdale, Clarence, Blackheath, Kowmung, Wingecarribee Swamp, Barren Grounds.

**Habitat**

**Habitat:** Swamp margins, riverbanks, roadside gutters.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Sedgeland with other *Juncus* spp. e.g. *J. cognatus, J. pauciflorus, J. gregiflorus.*
**Substrate:** Sandy alluvium from Tertiary sediments, granite, sandstone, low nutrients, damp places. Water table mostly high, moisture supply intermittent, fresh.
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown.

## *Juncus procerus* JUNCACEAE

### Life history

**Growth form:** Strongly rhizomatous perennial herb, with flowering stems 65–145 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST; Vic., Tas., S.A., N.Z., Chile.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Rookwood, Shellharbour, Coomonderry Swamp. **CT:** Luthers Creek, Boyd Crossing, Wingecarribee Swamp, Wildes Meadow.

### Habitat

**Habitat:** Moist sites, edge of swamps, creeks.
**Altitude:** 0–1000 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Shrubswamp e.g. with *Leptospermum obovatum, Baeckea utilis, Empodisma minus, Restio australis;* wet meadow e.g. with *Juncus effusus, J. sarophorus, J. procerus, J. acuminatus, Lycopus australis.*
**Substrate:** Sandy soils on alluvium, low nutrients, periodically inundated.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown. Reported in Kanangra Boyd NP.

## *Juncus radula* JUNCACEAE

### Life history

**Growth form:** Slender, shortly rhizomatous perennial herb, with flowering stems 20–65 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Smooth shiny capsule, with numerous seeds.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native, probably introduced to CT.
**Botanical subregions:** NT ?CT CWS SWS NWP SWP SFWP; Qld, Vic., S.A., W.A.
**Distribution Sydney area:** Lithgow area.
**Select locations: CT:** Mt Blaxland.

### Habitat

**Habitat:** Seasonally damp areas, hillsides.
**Altitude:** 800 m **Annual rainfall:** 800–900 mm
**Typical local abundance:** Occasional.
**Vegetation:**
**Substrate:**
**Exposure:**

### Conservation

**Conservation:** Probably introduced to CT (Harden 1993).

## ***Juncus remotiflorus*** (*J.* sp. *A* in Jacobs & Pickard, 1981) **JUNCACEAE**

### Life history

**Growth form:** Slender, shortly rhizomatous perennial herb, with flowering stems 15–70 cm high. Hybridizes with *J. subsecundus* (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Capertee River, Llandilo, Toongabbie, North Ryde, Fairfield, Engadine, Tahmoor. **CT:** Hill End, Oberon, Abercrombie Caves, Hill Top, Mittagong, Paddys River.

### Habitat

**Habitat:** Minor watercourses.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Woodland e.g. with *Eucalyptus polyanthemos, E. macrorhyncha, E. mannifera, E. amplifolia; Melaleuca* scrub e.g. with *Melaleuca decora, M. thymifolia, Eucalyptus parramattensis, E. sideroxylon.*
**Substrate:** Gravelly clay soils on slates, granite, shales, low nurients, ephemerally wet.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown. Reported in Royal NP.

## ***Juncus sandwithii*** **JUNCACEAE**

### Life history

**Growth form:** Shortly rhizomatous perennial or annual herb, more or less mat-forming (Wilson & Johnson 2001); flowering stems to 10 cm long
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:**
**Fruit/seed:** Smooth shiny capsule, with numerous seeds 5 mm long, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic., Tas., N.G.
**Distribution Sydney area:** Kanangra area.
**Select locations: CT:** Blackheath, Luthers Creek, Wheengee-whungee Swamps, Boyd Plateau.

### Habitat

**Habitat:** Damp areas, creekbanks.
**Altitude:** 1000–1200 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Swamp sedgeland and creekbanks e.g. with *Leptospermum obovatum, Hypericum japonicum, Isolepis subtilissima, Lilaeopsis polyantha.*
**Substrate:** Sandy soil on sandstones.
**Exposure:**

### Conservation

**Conservation:** Rare mat-forming plant restricted to high elevation wet areas. Reported in Kanangra Boyd NP.

## *Juncus sarophorus* JUNCACEAE

### Life history

**Growth form:** Shortly or strongly rhizomatous perennial herb, with flowering stems 55–170 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** CC SC NT CT ST CWS SWS; Vic., Tas., S.A., N.Z.
**Distribution Sydney area:** Tablelands.
**Select locations:** **CT:** Mt Coricudgy, Mullion Creek, Sunny Corner, Ben Bullen, Mt Canobolas, Kirkconnell, Bowenfels, Oberon, Mt Werong, Wingecarribee Swamp, Wildes Meadow.

### Habitat

**Habitat:** Damp and swampy situations.
**Altitude:** 500–1400 m **Annual rainfall:** 800–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Shrub swamp e.g. with *Leptospermum obovatum, Eucalyptus dalrympleana, Empodisma minus, Baloskion australis, Carex gaudichaudiana, Carex appressa;* wet meadow e.g. with *Eucalyptus bridgesiana, E. macrorhyncha, E. viminalis.*
**Substrate:** Clay soils on shale, alluvium, low to medium nutrients.
**Exposure:**

### Conservation

**Conservation:** Reported in Blue Mountains NP, Winburndale NR, Kanangra Boyd NP.

## *Juncus subglaucus* (*J.* sp. *U* in Jacobs & Pickard, 1981) JUNCACEAE

### Life history

**Growth form:** Shortly, strongly rhizomatous herb, with flowering stems 40–105 cm long. Hybridizes with other species (Harden 1993).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–May.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT CT NWS CWS NWP SWP; Qld.
**Distribution Sydney area:** Western Sydney, Bathurst area.
**Select locations:** **CC:** Doonside, Chullora. **CT:** Hill End, Bathurst.

### Habitat

**Habitat:** Swamps, creekbanks.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1000 mm
**Typical local abundance:** Occasional.
**Vegetation:** Swamps e.g. with *Eucalyptus amplifolia, Carex appressa, Juncus usitatus, Juncus polyanthemos.*
**Substrate:** Clay soils on shale, medium nutrients, periodically moist.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999), conservation status elsewhere unknown.

## *Juncus subsecundus* JUNCACEAE

### Life history

**Growth form:** Slender, shortly rhizomatous perennial; flowering stems terete, 25–90 cm long, cataphylls 3–11 cm long.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** October.
**Fruit/seed:** Capsule with numerous seeds, mucilaginous when wet, October–April.
**Dispersal, establishment & growth:** Diaspore mobile seed (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP NFWP; Qld, Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wollombi, Dora Creek, Wyong Creek, Spencer, Richmond, Galston, Hornsby, Cheltenham, Doonside, St Marys, Rookwood, East Hills, Oatley, Glenfield, Waterfall, Narellan, Dapto, Kangaroo Valley, Cambewarra Range. **CT:** Cudgegong Valley, Mt Darcy, Capertee, Mullion Creek, Mt Horrible, Nashdale, Mt Canobolas, Kirkconnell, Winburndale, Glanmire, Mt Blaxland, Blackheath, Wentworth Falls, Kowmung Creek, Wombeyan Caves, Robertson, Wildes Meadow, Bundanoon.

### Habitat

**Habitat:** Creeks, swamp margins.
**Altitude:** 0–1100 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Open-forest e.g. with *Angophora costata, Syncarpia glomulifera, Eucalyptus acmenioides, E. fibrosa, E. sideroxylon;* woodland e.g. with *Eucalyptus dalrympleana, E. bridgesiana, E. amplifolia, E. tereticornis.*
**Substrate:** Sandy to clay soils on sandstone, shale, alluvium, low to medium nutrients, periodically moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Juncus tenuis* * **JUNCACEAE**

### Life history

**Growth form:** Tufted perennial herb, with short rhizome; flowering stems 10–50 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–March.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Exotic, native to N America.
**Botanical subregions:** CC NT CT ST SWS; Vic., Tas.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Capertee Valley, Lindfield, Lane Cove, Neutral Bay, Domain (1962), Centennial Park (1900), Waterfall, Belmore Falls. **CT:** Blackheath, Katoomba, Wentworth Falls, Lawson.

### Habitat

**Habitat:** Disturbed areas, roadsides, creekbanks, moist areas.
**Altitude:** 0–1000 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Creek vegetation, grassy areas.
**Substrate:** Sandy soils on alluvium, sandstone, low to medium nutrients, moist.
**Exposure:**

### Conservation

**Conservation:** Recorded for over a century. Naturalised mostly near areas of human disturbance.

## *Juncus usitatus* **JUNCACEAE**

### Life history

**Growth form:** Densely tufted, shortly rhizomatous perennial herb, flowering stems to 110 cm long. Hybridizes with *J. polyanthemus* (Harden 1993).
**Vegetative spread:** Spreads by rhizome, perhaps ? 10 cm per year.
**Longevity:** Indefinite.
**Primary juvenile period:** ? 3–4 years.
**Flowers:** Most of the year, peak January.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet, matures November–July.
**Dispersal, establishment & growth:** Diaspore: capsule, mobile (McIntyre et al. 1995), possibly wind/water-dispersed; seeds ? wind-dispersed, float but sink when disturbed, germinate without treatment establishing best in open bare areas, clay, cracks in rocks etc. Coloniser.
**Fire response:** Probably resprouts.
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS NWP SWP; Qld, Vic, *SA, *WA, NZ., N Cal.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Dora Creek, Wyong, Beecroft, La Perouse, Kurrajong, Milperra, Razorback, Albion Park, Kangaroo Valley. **CT:** Capertee Valley, Mullions Range, Katoomba, Yerranderie.

### Habitat

**Habitat:** Creekbanks, damp places, floodplains.
**Altitude:** 0–1000 m **Annual rainfall:** above 700 mm
**Typical local abundance:** Frequent–dominant.
**Vegetation:** Sedgeland or rushland e.g. with *Persicaria* spp. or woodland e.g. with *Eucalyptus amplifolia, E. macorhyncha, E. melliodora.*
**Substrate:** Clay soils from alluvium, shale, basalt, sometimes more sandy soils, low–medium nutrients. Water table mostly high–permanently high, fresh. Recorded on saline sites in western NSW (Semple 1993).
**Exposure:** Full sun.

### Conservation

**Conservation:** Conserved in Western Sydney (James et al. 1999). Reported in Blue Mountains NP.

## *Juncus vaginatus* JUNCACEAE

### Life history

**Growth form:** Shortly to strongly rhizomatous perennial herb, with flowering stems 30–100 cm long.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** October–April.
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, mucilaginous when wet.
**Dispersal, establishment & growth:** Diaspore mobile (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS; Qld, Vic., Tas., ?S.A., ?W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wolgan River, Laguna, Bucketty, Kellyville, Regentville, Leumeah, Menangle Park, Waterfall, Budgong. **CT:** Mt Coricudgy, Clarence, Mullion Range, Ben Bullen, Little Hartley, Carcoar, Blackheath, Wentworth Falls.

### Habitat

**Habitat:** Damp to wet situations, creekbanks, roadside, grassland.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1400 mm
**Typical local abundance:** Occasional–frequent.
**Vegetation:** Open-forest e.g. with *Eucalyptus dalrympleana, E. blaxlandii, E. pauciflora, E. viminalis;* woodland e.g. with *Eucalyptus dives, E. sclerophylla, E. tereticornis.*
**Substrate:** Sandy soil, gravelly clay on sandstone, basalt, alluvium.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## ***Luzula densiflora*** (*L. paucipila* ms) **JUNCACEAE**

### Life history

**Growth form:** Small, erect perennial grass-like herb, with robust tufts; flowering stems 11–50 cm long.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pale red brown, with creamy margins, spring–summer.
**Fruit/seed:** Smooth shiny, red-brown to yelow-brown capsule, with numerous seeds that have white ± fleshy appendages, October–November.
**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC NT CT ST NWS CWS SWS SWP; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Yengo Creek, Richmond, Kogarah (1893), Casula, Lake Illawarra, Shellharbour. **CT:** Orange, Mt Canobolas, Georges Plains, Hartley Vale, Oberon, Hampton, Marulan.

### Habitat

**Habitat:** Creekbanks, swamps.
**Altitude:** 0–1000 m **Annual rainfall:** 700–1200 mm
**Typical local abundance:** Occasional.
**Vegetation:** Eucalypt woodland e.g. with *Eucalyptus melliodora, E. bridgesiana;* heathy swamp e.g. with *Leptospermum myrtifolium, Leptospermum polygalifolium.*
**Substrate:** Clayey to peaty soils on alluvium, medium nutrients, moist.
**Exposure:** Shady sites.

### Conservation

**Conservation:** Conservation status unknown.

## ***Luzula flaccida*** (*L. flaccida* form A) **JUNCACEAE**

### Life history

**Growth form:** Small, erect perennial grass-like herb, with loose tufts; flowering stems 12–40 cm long.
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Red brown or dark brown, with creamy margins, spring–summer.
**Fruit/seed:** Smooth shiny, yellow-brown capsule, with numerous seeds that have white ± fleshy appendages, October–February.
**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC SC NT CT ST NWS CWS SWS; Vic., Tas.
**Distribution Sydney area:** Widespread.
**Select locations:** **CC:** Wisemans Ferry, Richmond, Milperra, Stanwell Park. **CT:** Gulf Stream, Clarence, Mt Cameron, Mount Tomah, Mt Bindo, Mittagong.

### Habitat

**Habitat:** Hillsides, gullies.
**Altitude:** 0–1400 m **Annual rainfall:** 600–1400 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Open-forest e.g. with *Eucalyptus radiata, E. viminalis, E. dalrympleana, E. pilularis, Syncarpia glomulifera;* woodland e.g. with *Eucalyptus sclerophylla, Angophora floribunda, Eucalyptus rossii, E. dives.*
**Substrate:** Clay soil on basalt, shale, also sandy alluvial soil, low to high nutrients.
**Exposure:**

### Conservation

**Conservation:** Vulnerable in Western Sydney (James et al. 1999). Conservation status elsewhere unknown. Reported in Dharug NP, Tarlo River NP, Winburndale NR.

## *Luzula meridionalis* JUNCACEAE

### Life history

**Growth form:** Small, erect perennial grass-like herb, with slender tufts; flowering stems 18–30 cm long. Hybridizes with *L. flaccida* (Harden 1993).
**Vegetative spread:** No (McIntyre et al. 1995).
**Longevity:**
**Primary juvenile period:**
**Flowers:** Red-brown to dark brown, spring–summer.
**Fruit/seed:** Smooth shiny, pale yellow-brown to red-brown capsule, with numerous seeds that have white ± fleshy appendages.
**Dispersal, establishment & growth:** No particular morphology for dispersal (McIntyre et al. 1995).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST NWS CWS SWS; Vic., Tas., S.A., W.A.
**Distribution Sydney area:** Upper Blue Mountains.
**Select locations:** CT: Mt Coricudgy, Mt Towinhingy, Mt Wilson.

### Habitat

**Habitat:** Mountain tops.
**Altitude:** 800–1250 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Grassland understorey e.g. with *Ranunculus* in open-forest e.g. with *Eucalyptus viminalis, E. dalrympeana, E. radiata, E. blaxlandii.*
**Substrate:** Clay loam on basalt, high nutrients.
**Exposure:**

### Conservation

**Conservation:** Restricted to high elevation basalt caps. Conservation status unknown.

## *Luzula modesta* JUNCACEAE

### Life history

**Growth form:** Small, erect perennial grass-like herb, with tallish tufts from extensive rhizomes; flowering stems 18–50 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pale brown to red-brown, with whitish margins, spring–summer.
**Fruit/seed:** Smooth shiny, red-brown or pale brown capsule, with numerous seeds that have white ± fleshy appendages, November–January.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic., Tas.
**Distribution Sydney area:** Tablelands.
**Select locations:** CT: Kelgoola, Ilford, Mt Canobolas, Newnes Plateau, Blackheath, Hampton.

### Habitat

**Habitat:** Swamp margins.
**Altitude:** 700–1100 m **Annual rainfall:** 900–1200 mm
**Typical local abundance:** Frequent–rare.
**Vegetation:** Sedge swamp e.g. with *Lepidosperma limicola, Restio australis, Leptospermum myrtifolium;* woodland e.g. with *Eucalyptus pauciflora, E. dives, E. viminalis.*
**Substrate:** Peaty to sandy soils on sediments, sandstone, basalt, low to medium nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Luzula ovata* JUNCACEAE

### Life history

**Growth form:** Small, erect perennial grass-like herb, with slender tufts; flowering stems 10–35 cm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** Pale red-brown, with broad creamy to whitish margins.
**Fruit/seed:** Smooth shiny, ruby red or ox-blood red capsule, with numerous seeds that have white ± fleshy appendages, November.
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NT CT ST; Vic.
**Distribution Sydney area:** Tablelands.
**Select locations:** CT: Mt Canobolas, Oberon, Boyd River, Tuglow Caves, Moss Vale.

### Habitat

**Habitat:** Swamps at high altitudes.
**Altitude:** 600–1000 m **Annual rainfall:** 800–1000 mm
**Typical local abundance:** Occasional–rare.
**Vegetation:** Upland wetland e.g. with *Carex appressa, Eleocharis gracilis;* woodland e.g. with *Eucalyptus viminalis, E. pauciflora.*
**Substrate:** Peaty loam, low nutrients, permanently moist.
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Maundia triglochinoides* JUNCAGINACEAE

### Life history

**Growth form:** Erect rhizomatous perennial herb with spongy, inflated leaves
**Vegetative spread:** Tufts of leaves arise along rhizome.
**Longevity:**
**Primary juvenile period:**
**Flowers:** November–January. Pollination probably anemophilous (dispersed by wind) (Cook 1990).
**Fruit/seed:** Smooth shiny dehiscent capsule, with numerous seeds, December–January.
**Dispersal, establishment & growth:** Diaspore: seeds and root tubers, probably dispersed by water (Cook 1990).
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC; Qld.
**Distribution Sydney area:** Coastal.
**Select locations:** **CC:** Wyong Creek, Tuggerah, Kogarah Swamp (1903), Sans Souci (1903).

### Habitat

**Habitat:** Swamps, creeks.
**Altitude:** 0–200 m **Annual rainfall:** 1100–1200 mm
**Typical local abundance:** Rare.
**Vegetation:** Wetland vegetation e.g. with *Triglochin procerum.*
**Substrate:** Shallow fresh water 30–60 cm deep, over clay, low nutrients.
**Exposure:**

### Conservation

**Conservation:** Listed as Vulnerable (schedule 2) NSW *Threatened Species Conservation Act 1995.*

## *Triglochin microtuberosum* (incl. in *T. procerum* s. lat.) JUNCAGINACEAE

### Life history

**Growth form:** Robust, emergent aquatic perennial herb, with small roundish tubers 4.5–13 mm long. Numerous small distinctive tubers terminate in very short roots, clustered closely against the horizontal rhizome (Aston 1995).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–May, peak November–April (Aston 1993).
**Fruit/seed:** Smooth shiny capsule 7–10 mm long, with numerous seeds. Fruit is pear-shaped, with squat summit and stalk-like base, with absence of dorsal ridges (Aston 1995), mature August–May, peak November–April (Aston 1993).
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:** Swollen roots baked and eaten by Aboriginal people (Cribb & Cribb 1984). Heavily grazed by cattle and sheep when stock gain access after falls in water levels (Aston 1995).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic.
**Distribution Sydney area:** Western Sydney, Illawarra coast.
**Select locations:** **CC:** Richmond, Vineyard, Leumeah, Cobbitty, Dapto, Albion Park.

### Habitat

**Habitat:** Swamps, swampy creeks, dams.
**Altitude:** 0–200 m **Annual rainfall:** 800–1000 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Swamp vegetation e.g. with *Melaleuca ericifolia, Eleocharis sphacelata, Juncus usitatus, Cyperus gunnii, Myriophyllum, Triglochin procerum, Cotula coronopifolia, Ludwigia peploides, Potamogeton ochreatus* (Aston 1993).
**Substrate:** Stationary or gently flowing fresh water to 50(–120) cm deep in seasonal to permanent swamps, stagnant water, often highly eutrophic and humic with farm run-off, rotting vegetation and cattle dung or clear flowing water; rhizomes and roots embedded in fine black humic silt, loamy-peat, grey loam, loamy to gravelly sand, mud or clay (Aston 1993).
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

## *Triglochin multifructum* JUNCAGINACEAE

### Life history

**Growth form:** Perennial aquatic herb, with thick, woody horizontal to upcurved rhizomes and tubers 13–40 mm long.
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** August–May (Aston 1993).
**Fruit/seed:** Small round fruits to 5 mm long, with up to 1000 on each infructescence, October–June (Aston 1993).
**Dispersal, establishment & growth:**
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC NT ST NWS CWS SWS; Qld, Vic., N.T., S.A.
**Distribution Sydney area:** Sporadic.
**Select locations:** **CC:** Wollondilly River. **CT:** Boyd River.

**Habitat**

**Habitat:** Damp soil, swamps, lagoons, riverbanks.
**Altitude:** 0–600 m **Annual rainfall:** 800–1100 mm
**Typical local abundance:** Occasional.
**Vegetation:** Frequently co-exists with *Triglochin procerum* (Aston 1993).
**Substrate:** Fresh still to slow-flowing, usually clear water to 70 cm deep, surviving on saturated to damp soils left above receding waters; rhizomes and roots embedded in sandy to heavy grey clays overlain with soft silt and in red-grey loamy clay (Aston 1993).
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown.

## *Triglochin procerum* JUNCAGINACEAE

Water Ribbons

**Life history**

**Growth form:** Perennial aquatic herb, with thick, semi-horizontal woody rhizomes; an eastern variant occurs in coastal or near-coastal areas (Aston 1995).
**Vegetative spread:**
**Longevity:**
**Primary juvenile period:**
**Flowers:** September–December.
**Fruit/seed:** Capsule 7–14 mm long.
**Dispersal, establishment & growth:**
**Fire response:** Probably resprouted after high intensity fire 1/1994 (at Narrabeen), fruiting in 20 weeks (P. Kubiak pers. comm.).
**Interaction with other organisms:** Has been a staple food of Aboriginal people in northern and south-eastern Australia (Aston 1995). Plays an important role in transfer of methane from sediments to the atmospere (Muller et al. 1994).

**Distribution**

**Status/origin:** Native.
**Botanical subregions:** NC CC SC CT ST SWS; Qld, Vic., S.A.
**Distribution Sydney area:** Widespread.
**Select locations: CC:** Wheeny Creek, Tuggerah, McCarrs Creek, Gladesville, Doonside, Duck River, Centennial Park, Sans Souci, Botany, Kurnell, Leppington, Regentville, Mount Annan, Cobbitty, Albion Park. **CT:** Megalong Valley, Wingecarribee Swamp.

**Habitat**

**Habitat:** Swamps, creeks.
**Altitude:** 0–600 mm **Annual rainfall:** 800–1600 mm
**Typical local abundance:** Frequent–occasional.
**Vegetation:** Freshwater swamp e.g. with *Eleocharis sphacelata, Machaerima, Villarsia, Casuarina glauca.*
**Substrate:** Fresh, still to running water, upt o 1 m deep, rooted in sediment on alluvium, shale, sandstones, sand, low to medium nutrients, periodically drying out. Rhizomes and tubers are usually deeply subterranean e.g. with rhizomes 20–25 cm below soil surface and tubers 40–60 cm below (Aston 1995).
**Exposure:**

**Conservation**

**Conservation:** Conservation status unknown.

## ***Triglochin rheophilum*** (incl. in *T. procerum* s. lat.) **JUNCAGINACEAE**

Water Ribbons

### Life history

**Growth form:** Perennial aquatic herb, with thick, woody horizontal to vertical rhizomes.
**Vegetative spread:**
**Longevity:** Perennial.
**Primary juvenile period:**
**Flowers:** August–January (Aston 1993). Green, Sept. Probably insect pollinated.
**Fruit/seed:** Smooth shiny capsule 5–10 mm long, breaking into 6 mericarps (seeds) that fall from the spike on slight contact (mature November–January). Fruit 9–16 mm long, September–February (Aston 1993).
**Dispersal, establishment & growth:** Diaspore: mericarp, dispersal by water and perhaps by other vectors (Cook 1990), germinates freely with treatment on wet soil surface. Growth rate quick. Coloniser. Seedlings establish on saturated edge soils (Aston 1993).
**Fire response:**
**Interaction with other organisms:** Swollen roots baked and eaten by Aboriginal people (Cribb & Cribb 1984).

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; Qld, Vic., Tas.
**Distribution Sydney area:** Coastal Sydney.
**Select locations:** CC: Tunks Creek, Epping, Port Hacking River, O'Hares Creek.

### Habitat

**Habitat:** Restricted to clear, often swifly flowing, non-polluted flood-prone streams and rivers (Aston 1993).
**Altitude:** 0–300 m **Annual rainfall:** 900–1400 mm
**Typical local abundance:** Frequent.
**Vegetation:** Freshwater wetland e.g. with *Eleocharis sphacelata, Juncus usitatus, Paspalum distichum.* Sites in wet sclerophyll forest with thick shrub understoreys; creekbank vegetation e.g. with *Tristaniopis laurina, Tristania neriifolia, Callistemon subulatus* (Aston 1993).
**Substrate:** Fresh, gently to swiftly flowing, usually cold clear water to 1 m deep, with water level rises of 3–4 m; bedrock of sandstone/mudstone; rhizomes and roots embedded in thick sand or gravel, often secured beneath rocks (Aston 1993). Recorded on saline sites in western NSW (Semple 1993).
**Exposure:** No shade.

### Conservation

**Conservation:** Conservation status unknown.

## *Triglochin striatum* JUNCAGINACEAE

Streaked Arrowgrass

### Life history

**Growth form:** Slender, erect, rhizomatous herb to 30 cm high.
**Vegetative spread:**
**Longevity:** Perennial.
**Primary juvenile period:**
**Flowers:** September–May. Insect-pollinated (Cook 1990).
**Fruit/seed:** Smooth shiny capsule, with numerous seeds, October–May.

**Dispersal, establishment & growth:** Diaspore: mericarps, dispersed by water and perhaps by other vectors (Cook 1990), buoyant for 10 days in both tapwater and seawater (Clarke & Hannon 1970). 52 % Germination in tapwater and 12 % in 20 % seawater (Clarke & Hannon 1970). No salt requirement; much less tolerant of high salt than *Sarcocornia or Suaeda* for growth and germination but a small percentage of individuals can survive high salinities (Clarke & Hannon 1970)
**Fire response:**
**Interaction with other organisms:**

### Distribution

**Status/origin:** Native.
**Botanical subregions:** NC CC SC; LHI, Qld, Vic., Tas., N.T., S.A., W.A., S Afr, Amer., N.Z.
**Distribution Sydney area:** Coast and estuaries.
**Select locations:** CC: Gunderman, Wondabyne, Patonga Creek, Narrabeen, Dee Why Lagoon, Toongabbie, Parramatta, Gladesville, Newington, Homebush Bay, Cooks River, Rockdale, Hurstville, Leppington, Cronulla, Cape Solander, Woolooware Bay, Port Hacking, Wollongong, Lake Illawarra, Berry.

### Habitat

**Habitat:** Saltmarsh, shallow saline aquatic habitats, moist areas on coastal cliffs.
**Altitude:** 0–10 m **Annual rainfall:** 1000–1400 mm
**Typical local abundance:** Frequent–occasional.

**Vegetation:** Saltmarsh, more frequently waterlogged (either by sea or rainwater) and hence less saline parts, generally confined to small pools (Clarke & Hannon 1970); creek flat e.g. with *Mimulus repens, Cotula coronopifolia.*
**Substrate:** Clay soils, alluvium, shale, medium nutrients, periodically unundated. Saturated conditions necessary for adventitious growth; plants in freely-drained conditions failed to survive and there was a marked decrease in density in dry seasons (Clarke & Hannon 1970)
**Exposure:**

### Conservation

**Conservation:** Conservation status unknown.

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Scientific names are in bold type and synonyms are in italics. Family names are in upper case. Common names are in roman type. Exotic species are indicated by an asterisk following the botanical name.

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